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Body-scale Relationship of Brook Trout, *Salvelinus fontinalis*, in Michigan[1]

EDWIN L. COOPER

THE present paper is the second in a series dealing with the growth of the brook trout in Michigan. In the previous publication (Cooper, 1951) the validity of the annulus as a true year-mark was established principally on data from known-age fish. This confirmation of the scale method, generally accepted for most other species of fish, was felt necessary because of the skepticism of earlier published reports on age of brook trout (Kendall and Dence, 1927, 1929; Ricker, 1932; and King, 1942).

Once the validity of the annulus as a year-mark is established, it is possible to compare growth of individual fish or of fish from different localities. The methods of tabulating fish according to scale-age and actual lengths cannot be applied with accuracy unless all fish are taken on or near the same date. Unfortunately, all previous students of growth in brook trout, except Hazzard (1932, 1935) and Shetter and Leonard (1943), have used actual lengths of fish caught at different seasons, usually with no regard for the large variation in age in months within each age group.

A better means of determining rate of growth is by calculating the past growth of fish from scale measurements. Here, lengths and ages are strictly comparable because all calculated lengths are those attained at the end of completed seasons of growth. This method has been widely and successfully used for many species of fishes, and has been reviewed in detail by Van Oosten (1929). The method is based on the assumption that the scale size increases in proportion with increase in the length of the fish. In order to apply it, one must first determine the relationship between the growth of the scale and the growth in length of the fish.

Scale-Sampling Procedure

Key scales, i.e., identically located, must be used for a critical study of body-scale relationship. Because brook trout scales are so small and so often regenerated, it was not feasible to use exact key scales; however, approximate key scales were obtained by restricting the sampling to a certain small area. The sample area selected for this study, on the basis of scale size, uniformity and ease of reading, was the first few scale rows immediately below the lateral line just anterior to the anus.

Of the approximately 50 scales which composed each sample, five were mounted in glycerin-gelatin medium and studied with the aid of a scale-projection machine at a magnification of 90 diameters. All measurements of projected images were made with a millimeter rule at this magnification. Since annuli usually cannot be distinguished on the exposed (posterior) portion of the scale, the distance from the center of the focus to the approximate midpoint of the anterior margin of the scale (anterior scale radius) was used as the scale length. Measurements from center of focus to annuli were made on the same radius. All five of the scales on each slide were measured in this way.

The standard length of the fish in millimeters was used in all computations of body-scale relationship. Previous growth history also was computed on this basis. However, the data in Table I are given in total lengths in inches, following the suggestion of Hile (1948). The conversion of standard length to total length was made from the empirically determined relationship as follows:

$$\text{Total length} = 1.4137 \text{ standard length}^{0.964}.$$

[1] A contribution from the Michigan Institute for Fisheries Research.

Body-Scale Relationship

Hazzard (1932), in calculating the previous growth history of brook trout, assumed that the body-scale relationship could be expressed as a straight line, with an intercept on the length axis corresponding to the length of the fish at the time scales first appear. This was in line with the proposals of Johnston (1905) and Fraser (1916). Hazzard stated that the calculated average lengths determined from the use of this formula were found to be consistent with the actual average lengths of the year classes. However, since most of his specimens were taken by angling some time after growth had started in the spring, no extensive comparison between the calculated lengths and actual lengths of the fish at the time of annulus formation was possible. Shetter and Leonard (1943) also used a direct proportion method in their calculation of previous growth history of brook trout in Hunt Creek, Montmorency County, Michigan.

In the present study, when the empirical data were plotted, it was apparent that the body-scale relationship could best be expressed by a curve, rather than by a straight line (Fig. 1). As the fish grows in length, the scale lags behind, producing a simple depressed curve. Minor differences in the form of the curve were noted for the different populations and even among the sexes, but in every case a satisfactory fit of the data was obtained by using the general formula:

$$ASR = CL^n$$

where ASR = anterior scale radius, L = standard length in millimeters, and C and n are constants to be determined empirically.

In this general formula, because the exponent n determines the slope of the line, the differences between the values of n and 1.0 indicate the amount of deviation of the curve from a straight line. Thus the body-scale relationship curve of the Gangle Lake population is more depressed than any of the other populations examined (Table I). The variation in values of n for the different populations is considerable, being 0.630 for Gangle Lake and 0.843 for the Pigeon River.

Scales from different portions of the body were studied to determine the amount of difference in body-scale relationship due to this factor. Two body areas were sampled, one anterior to the dorsal fin and above the lateral line, the other immediately anterior to the anus and below the lateral line. For the most part, the same individual fish were included in the sampling from both body areas. This

Table I

Body-scale Relationship of the Brook Trout in Michigan

Locality, Sex or Method	Number of fish	Range in total length in inches	Body-scale relationship $ASR =$
All localities combined.* Posterior "key" position	1,430	1.7–15.8	$0.781\ L^{0.802}$
All localities combined.* Anterior "key" position	1,234	2.2–16.0	$0.415\ L^{0.900}$
N. Br. Au Sable River, Crawford County	546	2.4– 8.7	$0.830\ L^{0.801}$
Hunt Creek, Montmorency County	620	2.4– 7.8	$0.641\ L^{0.832}$
Pigeon River, Otsego County	532	2.4– 7.8	$0.782\ L^{0.843}$
Sucker Creek, Alcona County	442	2.4– 9.6	$0.848\ L^{0.729}$
Gangle Lake, Montmorency County	827	2.4– 8.3	$0.552\ L^{0.630}$
All males combined	673	2.4– 7.8	$0.700\ L^{0.828}$
All females combined	697	2.4– 7.8	$0.854\ L^{0.780}$
Johnston (1905)	...	...	Direct proportion
Fraser (1916)	...	...	Direct proportion plus correction

* See caption to Figure 1 for list of localities sampled.

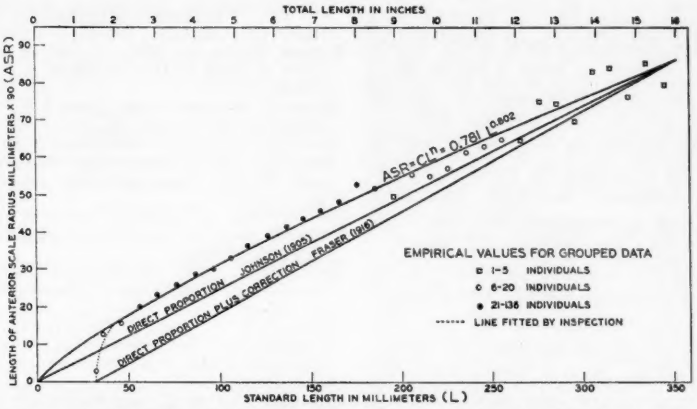

Fig. 1. Body-scale relationship of the brook trout in Michigan. Scales taken from the body immediately anterior to the anus and just below the lateral line. Combined data from 1,430 brook trout from Gangle Lake, East Fish Lake, Hunt Creek, the Upper Black River (all in Montmorency County), Sucker Creek in Alcona County, and the North Branch of the Au Sable River in Crawford County.

TABLE II

COMPARISON OF THE TOTAL LENGTHS IN INCHES OF BROOK TROUT AT VARIOUS ANNULI, CALCULATED* BY DIFFERENT METHODS

Locality, Sex or Method	I	II	III	Margin
All localities combined.† Posterior "key" position	2.6	5.8	9.5	12.5
All localities combined.† Anterior "key" position	3.0	6.3	9.6	12.5
N. Br. Au Sable River, Crawford County	2.6	5.8	9.5	12.5
Hunt Creek, Montmorency County	2.7	6.0	9.6	12.5
Pigeon River, Otsego County	2.7	6.1	9.7	12.5
Sucker Creek, Alcona County	2.2	5.4	9.3	12.5
Gangle Lake, Montmorency County	1.7	4.8	8.9	12.5
All males combined	2.7	5.9	9.6	12.5
All females combined	2.4	5.7	9.4	12.5
Johnson (1905)	3.5	6.8	10.1	12.5
Fraser (1916)	4.8	7.6	10.4	12.5

* Scale readings used are as follows: Annulus I–20, Annulus II–40, Annulus III–60, Margin–75.
† Numbers of fish involved are the same as listed in Table I.

comparison indicated that the body-scale relationship was quite different between the samples (1,234 and 1,430, respectively) drawn from the two body areas; values of n were 0.802 in the posterior position and 0.900 in the anterior position (Table I). A comparison of the sexes as to body-scale relationship disclosed a small but significant difference in n, cf., 0.828 for males and 0.780 for females (Table I).

COMPUTATION OF PREVIOUS GROWTH HISTORY

The most accurate method of computing growth history of individual fish would be to use the body-scale relationship obtained for

the particular population, sex, and body area in question. However, a great saving of time would be effected by using a general curve derived from some prior study—a desirable procedure, provided that resultant errors are minor. An estimate of these errors may be obtained by comparing the values calculated by using different body-scale relationship curves. Such a comparison has been made (Table II) for a hypothetical brook trout 12.5 inches long and in its fourth summer of life. The direct-proportion method with a correction added to compensate for the size of the fish at the time of scale formation, as proposed by Fraser (1916), results in extreme error when applied to the Gangle Lake population, or to most of the other populations. The direct-proportion method, also, results in considerable error in calculating earlier growth history. The data from some of the other populations, such as for the North Branch of the Au Sable River, the Pigeon River, and Hunt Creek, might be logically combined in the calculation of previous growth history without sacrificing much in accuracy.

ACKNOWLEDGMENT

The data used in this report were obtained with the assistance of many different persons connected with the Michigan Department of Conservation. This assistance is gratefully acknowledged. Dr. A. S. Hazzard supervised the study and Dr. Ralph Hile furnished valuable advice in the interpretation of the results.

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The Status of the Carangid Fishes *Trachurus* and *Decapterus* on the Pacific Coast of Canada and the United States

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IN 1947, the jack mackerel, *Trachurus symmetricus* (Ayres), became of major commercial importance in California. Concurrently the California Division of Fish and Game undertook a biological study of the species which is being continued. It soon became apparent that there was considerable confusion both in the literature and in the minds of many workers in the field as to the status of *Trachurus* and *Decapterus* on the Pacific coast, and it was necessary to make a systematic study of both genera. Since it will not be possible to publish detailed findings in the near future the salient facts resulting from this investigation are here presented.

All of the specimens referred to these genera in the California Academy of Sciences and Stanford University collections were checked

in an effort to clarify their relationships and to determine good key characters by which they could be readily differentiated. These collections contained material from all oceans though all known species were not represented. In addition, meristic counts and measurements have been made on over 1100 *Trachurus symmetricus*, 145 *Decapterus* from the Baja California coast, and 20 *Decapterus* from the Hawaiian Islands.

Trachurus can be most readily distinguished from *Decapterus* by the presence of a dorsal anterior accessory lateral line, which is not developed on *Decapterus*. *Trachurus* also has enlarged scales over the entire length of the lateral line while *Decapterus* has enlarged scales only along the posterior portion. The last ray of both the dorsal and anal fins of *Trachurus*, while often finlet-like in structure, is not separated by much more than the average interradial distance from the preceding ray of either fin and is usually connected to the preceding ray by a membrane. *Decapterus* on the other hand has dorsal and anal finlets which are widely separated from the terminal rays of their respective fins. (Norman, 1935, described *D. rhonchus* as having a connecting membrane; none of this species was available in our study.)

The more than 1100 *Trachurus symmetricus* comprised a series ranging in standard length from 93 to 557 mm. and were collected from Oregon to central Baja California, México (San Juanico Bay, lat. 26° 15′ N., long. 112° 28′ W.). A few very large individuals were caught as far offshore as 600 miles west of Los Angeles Harbor. On the basis of these 1100 fish, we conclude that in *T. symmetricus* the accessory lateral line usually extends to the insertion of the second dorsal fin. It may end as far forward as the fourth dorsal spine or as far posterior as the fifth dorsal soft ray. All scales in the lateral line are enlarged. The lateral line is curved abruptly downward about under the insertion of the second dorsal and becomes straight under the eighth to eleventh dorsal ray. The length of the chord of the curved portion is usually, but not always, greater than the length of the straight portion. Scales number 52 (41–59) in the curved portion and 46 (40–55) in the straight; total scales are 99 (87–111). Other counts are: gill rakers 15 (13–18) + 41 (37–45) = 56 (51–61); gill teeth, 7 (5–9) + 27 (25–30) = 34 (31–39); first dorsal fin, XIII; second dorsal I, 33 (28–38); anal II-I, 29 (22–33). The last dorsal and the last anal rays become progressively more finlet-like in structure as the fish grows, and in large individuals appear to be detached finlets. However, a very fine membrane or its remnants can usually be detected in carefully handled individuals.

The Stanford University collection contains the type (S.U. 14375) of *D. polyaspis* Walford and Myers (1944) and six other specimens referred to that species (S.U. 14376, 14378–79; 3 uncataloged). All prove to be typical large (380–511 mm. S.L.) *T. symmetricus*. These fish were caught off the British Columbia and Oregon coasts, and agree in all respects with fish of similar size obtained off California. *D. polyaspis* must therefore be regarded as a synonym of *T. symmetricus*.

T. symmetricus appears separable from the Peruvian *T. murphyi* Nichols. We examined two specimens from Callao, Perú, one in the Stanford collection (S.U. 11951) and the other in the collection of the Allan Hancock Foundation of the University of Southern California (uncataloged). These fish, 275 and 323 mm. S.L., have long pectorals contained 3.2 times in the standard length. In 200 California fish from 250 to 350 mm. S.L., the pectoral was contained 3.6–4.5 times in the standard length. As suggested by Hildebrand (1946), the highest scales in the curved and straight portions of the lateral line are relatively smaller in *symmetricus* than in *murphyi*. In 110 California fish, 126–443 mm. S.L., the highest scale in the curved portion was 9.5–14.1 percent of head length, compared to 18.3 and 19.8 percent in the two Perúvian specimens. In the straight portion the values were 12.2–16.9 percent for *symmetricus* and 18.3 and 20.0 for *murphyi*.

On the basis of published descriptions and comparisons with the specimens available to us, *T. symmetricus* appears to be readily distinguishable from all other species except the Atlantic *T. picturatus* (Bowdich). A direct comparison of material will be necessary before the relationship of these two can be determined.

Only one species of *Decapterus* is known definitely to occur north of the México boundary. This we tentatively refer to *D. hypodus*

Gill. It appears to be quite abundant in the central portion of Baja California and at Guadalupe Island and it has been taken several times at Los Coronados Islands, just south of the Méxican boundary. So far, however, we have but one definite record from California waters, a specimen from San Clemente Island taken by the California Division of Fish and Game research vessel YELLOWFIN in September, 1950. The specimen described by Croker (1937) as *D. sanctaehelenae* is certainly a *Decapterus* and perhaps *D. hypodus* although the total scale count (118–120) is high. Identity of the specimen from Monterey Bay which Clark and Halstead (1938) considered as *D. scombrinus* (Valenciennes) remains uncertain.

Based on 145 specimens of *D. hypodus* (157–412 mm. S.L.) from Baja California, the scales number 66 or 67 (55–74) in the curved portion of the lateral line, 41 (37–49) in the straight portion, and total 108 (99–116). The lateral line is gently deflexed anteriorly, becoming straight under the 14th (11–16) dorsal ray. Other counts are: gill rakers 14 (13–16) + 39 (37–42) = 53 (50–58); gill teeth 7 (6–9) + 23 (22–26) = 30 (29–34); first dorsal VIII; second dorsal I, 31 (29–33)-I; anal II-I, 26 (25–29)-I. The pectoral extends to a point under the sixth to eighth dorsal spine. Weak teeth are present on tongue, vomer, palatines and lower jaw; a few teeth are usually present on the upper jaw. Dorsal and anal finlets are widely separated from the preceding rays.

The relationship of these Baja California fish to described species from the Pacific area, particularly those from the Galapagos Islands and Perú, remains to be determined. They are separable from 20 specimens of *D. pinnulatus* (Eydoux and Souleyet) from Hawaii which were supplied through the kindness of Mr. Vernon E. Brock. The most striking difference is the number of scales in the lateral line, for the Hawaiian fish have 125–130 (versus 99–116). The relationship of the Méxican fish to the Galapagan *D. scombrinus* cannot now be determined for lack of sufficient material. However, two rather badly damaged specimens in the Stanford collection (S.U. 12263–64) suggest that *scombrinus* has longer pectorals. Hildebrand's (1946) *D. afuerae* from Perú is described as having fewer gill teeth and rakers.

In summary, there is but a single species of *Trachurus* off the Pacific coast of North America. *T. symmetricus* ranges from British Columbia at least to central Baja California and to a distance of several hundred miles from shore.

The only *Decapterus* known to occur north of the Méxican boundary is *D. hypodus* and it is definitely recorded only from Southern California. It is abundant in the northern half of Baja California; the southern limit of its range is unknown.

D. polyaspis is based on large specimens of *T. symmetricus* and is placed in synonymy with it.

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Taxonomic Status of the Percid Fish *Poecilichthys radiosus* in Oklahoma and Arkansas, with the Descriptions of Two New Subspecies[1]

GEORGE A. MOORE AND CARL C. RIGNEY[2]

IN a recent review of *Poecilichthys whipplei* (Girard), Hubbs and Black (1941) divided the species into *P. w. whipplei*, of the Arkansas River System, *P. w. radiosus*, a new form from the Red River System, and *P. w. montanus*, a new subspecies of restricted range in mountainous tributaries of the Arkansas River in western Arkansas. *Poecilichthys artesiae* Hay, from east of the Mississippi River, was also referred to subspecific status in *P. whipplei*.

In the present paper *Poecilichthys whipplei radiosus* is elevated to specific rank, and its known range is extended westward to the Clear Boggy and Blue rivers in southern Oklahoma. Two new subspecies are described: *Poecilichthys radiosus cyanorum* from the Blue River, and *Poecilichthys radiosus paludosus*, from the Kiamichi and Clear Boggy rivers.

It is true that in many ways the characters of *P. whipplei* and *P. radiosus* overlap, a condition that should occasion no surprise in such a large genus. Many widely different species of *Poecilichthys* very evidently have ranges of variation that broadly overlap, and still the species are easily recognized as distinct. *P. whipplei* differs from *P. radiosus*, in some respects, just as conspicuously as *P. squamiceps* (Jordan) differs from *P. parvipinnis* (Gilbert and Swain) (Moore and Cross, 1950). The only question is, as Hubbs (1943: 113) implies, one of completeness or incompleteness of differentiation.

Although absence of intergradation is not proof in itself, of the distinctness of species, its presence is regarded as indication that the forms under consideration are conspecific. No intergradation between *radiosus* and *whipplei* is known.

The ranges of *P. whipplei* and *P. radiosus* indicate little chance of continuity. Indeed, isolation is evident, since the mouths of the Arkansas and Red rivers are widely separated by a long portion of the oldest segment of the very muddy Mississippi, which has doubtless been a darter barrier at least since the last glacial period. It is also significant that neither *radiosus* nor *whipplei* invade the ranges of each other by waterways such as the one between Rich Mountain and Black Fork Mountain, near the village of Eagleton, Arkansas. The canyon floor between these two high ridges drains westward into the Arkansas by way of the Poteau River System and eastward by the Ouachita into the Red River; during rainy weather the water flows both ways, the two rivers being continuous, so that it would seem quite possible for *P. radiosus* to go into the Poteau and *P. whipplei* to enter the Ouachita. Extensive collections have been made in the Poteau, but all *whipplei* specimens are typical. Collections were made in the Ouachita at Eagleton (June 3, 1947), but only good *radiosus* was taken. Some factor or factors evidently operate to prevent migration across the top few miles of the divide. On June 26, 1949, the writers collected in Big Creek, a tributary of Black Fork of the Poteau System two miles from its source, which is a spring that is said to flow into both the Ouachita River and Big Creek. The only darter species taken was *Poecilichthys spectabilis* Agassiz. The absence of *P. whipplei* in Big Creek may be explained on the basis of stream gradient and the rugged nature of the stream bed which is composed of boulders and rocks of considerable size, with no sand and little gravel.

METHODS

Only adult or half grown specimens were used for counts and measurements, since we had long series and since the inclusion of small specimens would have decreased precision. Most of the data were obtained by Rigney and later checked by Moore. When the two were significantly in disagreement, the counts or measurements were repeated until, according to the methods of Hubbs and Lagler (1947), accuracy was assured. Standard length was

[1] Contribution from the Research Foundation and No. 151 from the Department of Zoology of the Oklahoma Agricultural and Mechanical College. The writers are indebted to Dr. Carl L. Hubbs for his careful criticisms of the manuscript and for encouragement during the preparation of this paper.

[2] Carl C. Rigney, deceased May 11, 1950.

recorded to the nearest millimeter and all other measurements to the nearest estimated tenth of a millimeter. All computations were performed by machine.

For vertebral counts, specimens were partly macerated in potassium hydroxide, stained in alizarin, and cleared in glycerine. These, and a few dissected specimens, are not included as paratypes.

Color notes were taken from freshly killed and refrigerated specimens, at most not later than three days after killing.

Comparison of *Poecilichthys whipplei* and *P. radiosus*

P. whipplei differs most distinctly from *P. radiosus* in the presence of conspicuous red spots (readily discernible, in Pl. I, Fig. 1, as lighter areas on the sides of the adult male). Females of *whipplei* (Pl. I, Fig. 2) have less conspicuous spots which vary from yellow, as in juveniles, to red. Our observations, in regard to the presence or absence of red spots, are in agreement with those of Jordan and Gilbert (1886: 13), but not with those of Hubbs and Black (1941: 5, 6, 11, and 12) who stated that *radiosus* has red spots.

Freshly killed specimens of *whipplei*, collected by Leah and G. A. Moore from Pryor Creek, 1 mile south of Pryor, and Crutchfield Creek at Locust Grove, on May 8, 1949, differ from *radiosus* as follows: they lack bright colors on the head, there being only a wash of pale green on the cheeks, whercas *radiosus* has bright orange on the cheeks and gill membranes; the dorsal, caudal and anal fins (Plates I and II) are similar to those of *radiosus* but tend to retain the juvenile pattern of fine black bars longer in life.

The dusky pigment on the body of *whipplei* tends to form a reticulum (Pl. I, Fig. 1), seldom a row of blotches on the sides. In *P. radiosus* the reticulum is poorly developed or quite absent, and very frequently there is a row of rather conspicuous lateral blotches. Bars of black pigment, absent in *whipplei*, are often conspicuous on the caudal peduncle of *radiosus*.

In *whipplei* the bars below and behind the eye form a more acute angle with the lower bar projecting either vertically downward or diagonally backward, whereas in *radiosus* the two bars appear as an interrupted arc tangent to the orbit and with the lower portion projected vertically downward or obliquely forward.

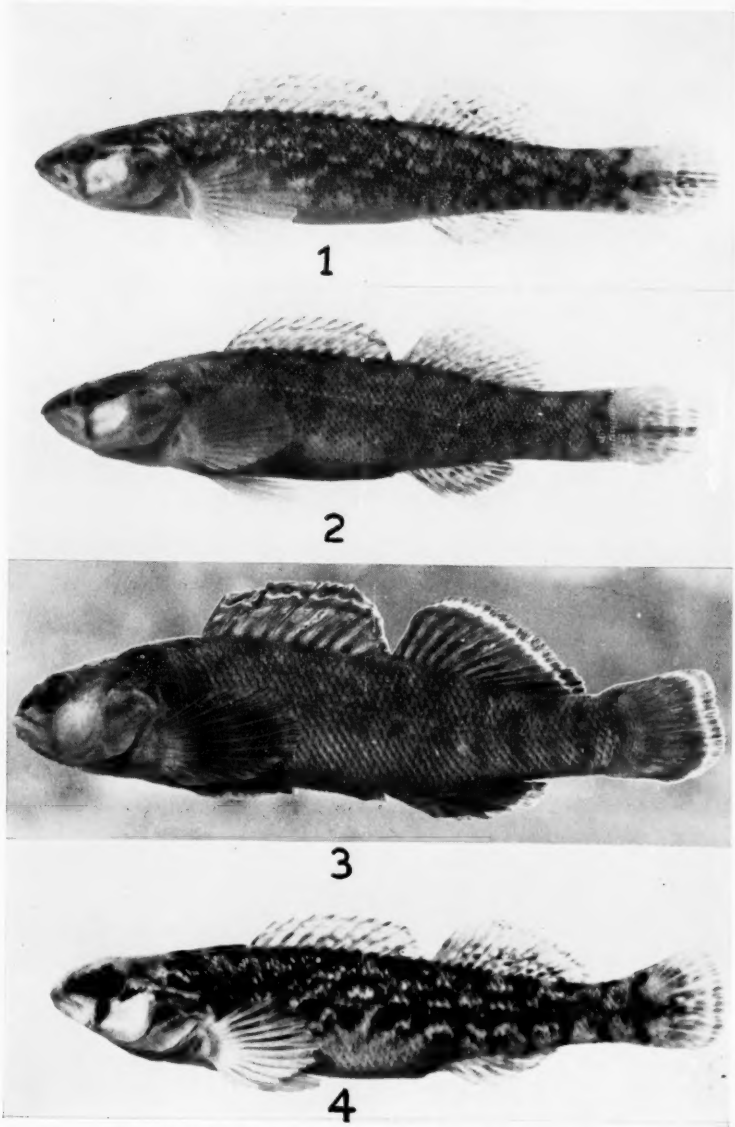
Sexual dimorphism is more pronounced in *P. radiosus*, in which even a half-grown individual can readily be sexed by an examination of the genital papilla, which in *P. whipplei* is typically smaller and very similar in both sexes. The papilla usually differs between the two sexes of *radiosus* quite uniformly: in males, it is semicircular to triangular and often has a slender pointed tip; in females, it is usually rectangular and greatly elongated and very often emarginate. Pigment is consistently present on the basal portion of the papilla in the male and either present or absent in the female.

In *P. whipplei* there are 37.8 (37–39) and in *P. radiosus* 36.1 (35–38) vertebrae (Table I).

The scale counts[3] constitute another very good difference when the combined subspecies of *P. radiosus* are compared with *P. w. whipplei*. We have not considered *P. w. montanus*, but Hubbs and Black indicated that the scales of this form are more numerous and, therefore, if it were included, the average differences would be even greater. If the break between *whipplei* and *radiosus* is placed between 61 and 62 scales, 92% of the specimens of *whipplei* and 96% of those of *radiosus* are identifiable on the basis of this character alone. Although the average differences in pored-scale and unpored-scale counts are quite significant (Table I), there is such wide variation that these characters have no diagnostic value when comparing *whipplei* with the combined subspecies of *radiosus*. However, when the four forms are examined separately, there is a geographic eastward trend toward a lower number of pored scales. *P. r. cyanorum* approaches *P. whipplei* (82% and 89%, respectively, with more than 46 pores), whereas *P. r. paludosus* and *P. r. radiosus* (77% and 86%, respectively) have fewer than 47. In other respects, *P. r. cyanorum* bears less resemblance to *P. whipplei* than does *P. r. radiosus*.

It is quite apparent that the two species are distinct in habitat preference. *P. whipplei* prefers sandy streams of low gradient and

[3] Our data pertaining to counts and measurements were analyzed, using the analysis of variance, by the Statistics Laboratory of the Oklahoma Agricultural and Mechanical College.



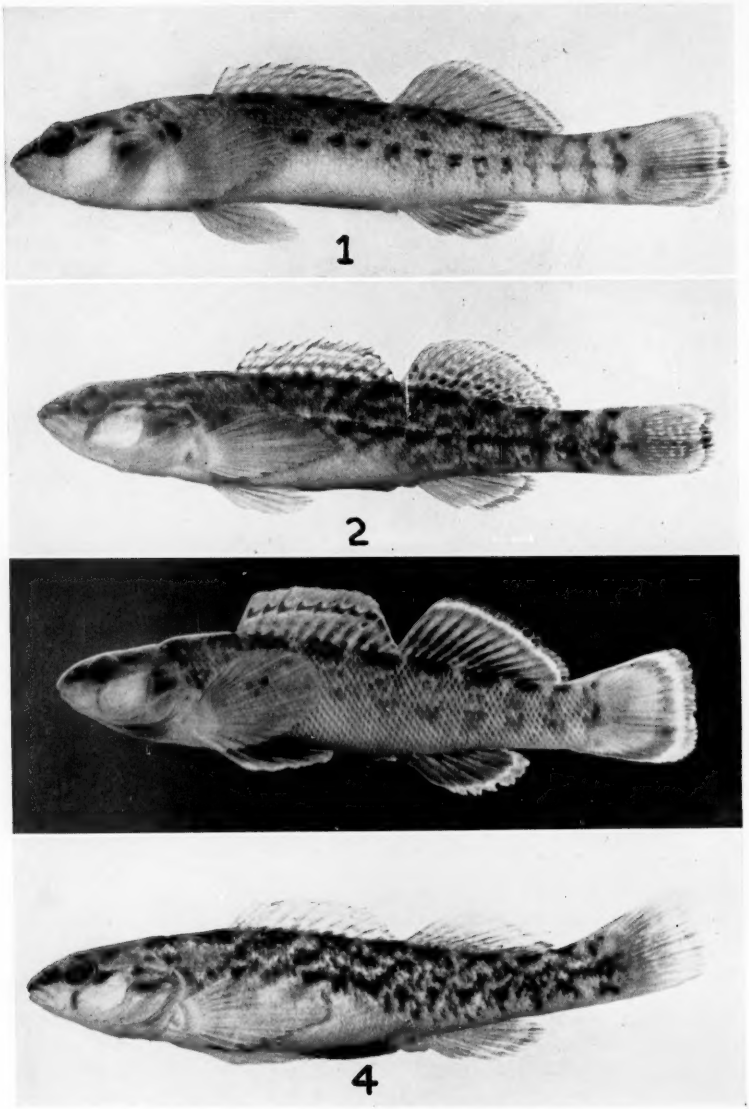
(Parenthetic figures represent the standard lengths in millimeters.)

Fig. 1. Adult male (55) *Poecilichthys whipplei whipplei* from Pryor Creek, 1 mile south of Pryor, Oklahoma.

Fig. 2. Adult female (52) *Poecilichthys whipplei whipplei*, from same place.

Fig. 3. Holotype (68) *Poecilichthys radiosus cyanorum*.

Fig. 4. Female paratype (55) of *Poecilichthys radiosus cyanorum* from Blue River, Oklahoma.



(Parenthetic figures represent the standard lengths in millimeters.)

Fig. 1. Adult male (46) *Poecilichthys radiosus radiosus* from Gulpha Creek near Hot Springs, Arkansas.

Fig. 2. Adult female (43) *Poecilichthys radiosus radiosus* from the Ouachita River on Highway 270, 5 miles northwest of Mount Ida, Arkansas.

Fig. 3. Holotype (47) *Poecilichthys radiosus paludosus.*

Fig. 4. Female paratype (38) of *Poecilichthys radiosus paludosus* from Bois d'Arc Creek, Pontotoc County, Oklahoma.

avoids the higher gradients and gravelly or rocky bottoms where *P. radiosus* is found. Hubbs and Black (1941) did not mention the nature of bottom preferred by *P. w. montanus*, but since they indicate it as a mountain headwater form, we assume that its habitat is quite different from that of the typical subspecies. In many collections made in the Illinois River in Oklahoma in 1946, *P. w. whipplei* was seldom taken over gravel. The only large series, however, came from near the mouth of the river. Furthermore, *whipplei* is rarely encountered east of the Grand (Neosho) River in Oklahoma but is often common in its western tributaries. The abundance of this species in the Poteau and its tributaries is attributed to the sluggish nature of that river, in which a bottom of sand and mud rather than gravel prevails. Although *radiosus* is often found in lowland steams, and sometimes even

TABLE I

COMPARISON OF *Poecilichthys whipplei whipplei* AND THREE SUBSPECIES OF *P. radiosus*
Means with extremes of variations in parentheses

Subspecies	*P. w. whipplei*	*P. radiosus* (3 subspecies)	*P. r. radiosus*	*P. r. cyanorum*	*P. r. paludosus*
Number of specimens	88	417	168	145	104
Lateral-line scales					
Total	65.55 (59–73)	55.70 (47–66)	56.02 (49–66)	55.54 (48–62)	55.5 (47–63)
Pored	51.25 (42–62)	45.12 (26–60)	41.93 (26–55)	49.62 (39–60)	44.03 (35–47)
Unpored	14.38 (6–23)	10.57 (0–26)	14.05 (5–26)	5.91 (0–13)	11.44 (4–21)
Fin rays					
Dorsal spines	11.32 (11–12)	10.49 (9–12)	10.56 (9–12)	10.38 (9–12)	10.54 (9–12)
Dorsal soft rays	13.84 (13–15)	13.67 (11–17)	13.93 (12–17)	13.15 (11–15)	13.97 (12–16)
Anal soft rays	7.89 (7–9)	7.41 (6–9)	7.40 (6–9)	7.28 (6–8)	7.62 (6–9)
Standard length	42.33 (27–62)	43.43 (28–71)	41.95 (28–61)	44.49 (29–71)	40.31 (32–60)
Head length in standard length	3.31 (3–3.6)	3.36 (2.9–3.8)	3.26 (2.9–3.8)	3.43 (3.2–3.7)	3.43 (3.1–3.7)
Head depth in standard length	6.12 (5.1–6.9)	5.68 (4.7–6.7)	5.79 (5.2–6.7)	5.35 (4.7–6.1)	5.98 (5.3–6.7)
Head depth in head length	1.85 (1.6–2.1)	1.69 (1.4–2.0)	1.77 (1.5–2.0)	1.56 (1.4–1.7)	1.73 (1.6–2.0)
Head depth in snout to preopercle	1.27 (1.1–1.5)	1.16 (0.9–1.5)	1.23 (1.1–1.4)	1.07 (0.9–1.5)	1.20 (1.1–1.4)
Snout in head	4.59 (4.1–5.6)	4.39 (3.5–5.8)	4.58 (3.7–5.8)	4.14 (3.5–4.9)	4.45 (3.8–5.3)
Eye in snout	1.15 (0.8–1.4)	1.10 (0.8–1.5)	1.08 (0.8–1.5)	1.14 (0.9–1.4)	1.09 (0.9–1.4)
Eye in head	5.26 (4.4–6.5)	4.83 (3.4–5.9)	4.93 (4.1–5.8)	4.69 (3.4–5.9)	4.88 (4.1–5.7)
Snout to union of gill membranes in head	1.76 (1.5–1.9)	1.72 (1.4–2.1)	1.75 (1.5–2.1)	1.69 (1.4–2.1)	1.72 (1.5–2.0)
Vertebrae	37.8 (37–39)	36.1 (35–38)	36.2 (35–38)	36.3 (36–37)	36.0 (35–38)
Specimens for vertebral counts	17	31	10	10	11

in swamps, it is particularly abundant in streams such as the Mountain Fork, Little and Ouachita rivers which have gravel bottoms, frequent boulders, and steeper gradients.

There is a possibility that the apparent habitat preference may be influenced by the presence or absence of competition. However, our largest collection of *P. whipplei* is from Slate Ford on the lower portion of the Poteau River near Shadypoint. This location yielded the longest species list of any station in the entire river survey. Competition would seem to be particularly keen at Slate Ford.

Statistical analysis shows significant to highly significant differences in all characters of *whipplei* and *radiosus* examined, but the actual values of these differences are often small because of the wide limits of variation in each species. Although they have retained a fairly similar form, *P. whipplei* and *P. radiosus* have diverged from each other markedly in several ways. The slenderer construction of the *whipplei* body is often evident, but when measurements of head length or depth in standard length are taken, the average difference is only 0.05 for the head length and 0.44 for head depth. The head-length range for *radiosus* includes the entire range of *whipplei* (Table I), but if the four forms are considered separately, the head length is usually contained more than 3.3 times in the standard length in *P. r. cyanorum* (82%) and in *P. r. paludosus* (72%), and usually less than 3.4 times in *P. whipplei* (66%) and in typical *P. r. radiosus* (85%). In its greater head depth, *P. r. cyanorum* contrasts sharply with the other three forms, in which the head enters the standard length more than 5.5 times in from 80% to 97% of the specimens studied.

In listing material examined, the following abbreviations are used: OAM, Oklahoma Agricultural and Mechanical College; UOMZ, University of Oklahoma Museum of Zoology; UMMZ, University of Michigan Museum of Zoology; USNM, United States National Museum; and MCZ, Museum of Comparative Zoology (Harvard College).

Poecilichthys radiosus cyanorum, subsp. nov.

TYPES.—The holotype (Pl. I, Fig. 3), an adult breeding male, UMMZ No. 161366, 68 mm. in standard length, was collected by Moore on April 4, 1949, from the Blue River, a tributary of the Red River, on U. S. Hwy. 99, T1S, R6E, Johnston County, Oklahoma.

The 329 paratypes, all collected by Moore and students from the Blue River and tributaries, bear the following data, with the number of specimens in each collection followed by the size range in millimeters and the Museum numbers: 96 (27.0–67.0), OAM No. 2913, taken with the holotype; same locality, April 5, 1947, 77 (32.0–70.0), UMMZ No. 161367; Blue River, 10 miles west of Wapanucka, 3 miles south of Hwy. 7, April 6, 1947, 11 (33.0–52.5), MCZ No. 37204; Little Blue River, T1N, R6E, northwest quarter Sec. 36, April 5, 1947, 82 (28.0–53.0), UOMZ, No. 26154; Bryan County, Cedar Creek, 7 miles east and 1 mile south of Durant, April 15, 1949, 15 (39.0–48.5), UOMZ No. 26155; Pontotoc County, Blue River, near its source, southwest of Ada, April 4, 1947, 48 (38.0–54.0), USNM No. 153532.

DIAGNOSIS.—*Poecilichthys radiosus cyanorum* differs from *P. r. radiosus* and *P. r. paludosus* in having a much blunter and more decurved snout, a deeper head, and a larger, heavier body; it has a lower average number of unpored scales, higher average number of pored scales, and greater sexual dimorphism expressed by a higher spinous dorsal in adult males (Pl. I, Figs 3 and 4).

DESCRIPTION.—The following data were taken from the very robust holotype (averages and extremes for the subspecies as a whole are presented in Table I): the back is little elevated, sloping in almost a straight line to the caudal peduncle, which is about the same depth throughout; the head, 3.3 in standard length, is quite blunt and, in profile, is sharply decurved from the eyes to the snout tip; head depth, 4.9 in standard length, 1.5 in head, and 0.96 in distance from tip of snout to preopercular margin; snout, 4.1 in head; eye, 1.2 in snout, and 5.0 in head; the mouth is of moderate size and is very slightly oblique; length of upper jaw, 3.2 in head; distance from tip of mandible to the union of the rather broadly-joined gill membranes, 1.95 in head; distance from tip of snout to dorsal origin, 2.9 in standard length; length of fifth dorsal spine, 7.72 in standard length; length of pectorals, 4.3 in standard length; depth of caudal peduncle,

2.3 in head; width of the genital papilla, at its base, nearly 2.0 times its distance from the vent.

The squamation of the holotype is as follows: lateral-line scales 58 (52 pored plus 6 unpored); 7 scales between lateral line and origin of second dorsal and 11 from the lateral line to origin of anal; around the caudal peduncle, at the least diameter, 24; large, exposed scales on upper and posterior borders of the opercles; cheeks, near the eyes, and the nape, with smaller exposed scales; breast with embedded scales.

The fin-ray counts are: D. X-13; A. II, 8; P_1, 12-12; P_2, I, 5; C. 17 (15 branched).

Color notes taken from the freshly killed holotype are as follows: the body is suffused with orange, which is intensified on the belly and diminishes toward the lateral line. Above the lateral line the ground shade is between light brownish olive and buffy olive. The back has 8 indistinct dark saddles. On the caudal peduncle and above the anal base the body is crossed by 5 indistinct vertical bars. The breast is dirty white, except along its anterior margin where the orange of the gill membranes extends backward. A deep blue-green bar, covering the black subocular bar, extends diagonally forward and downward to the edge of the mandible. From the occiput to the tip of the snout, including the preorbital region, the top of the head is blue-green slate. The basal half of the spinous dorsal is of mixed brown and buffy olive and is followed by an orange band one-fourth the height of the fin, which is bordered with a blue-green band of the same width as the orange band but not covering the last two spines; a very narrow creamy-white band lies between the two. The soft dorsal and caudal are similarly colored, except that the creamy-white band is broader. The anal, basally orange, is tipped with blue-green. The pelvics are blue-green, with some orange near the tips of the anterior rays; the pectorals are primarily orange with pale tips.

HABITAT.—*P. r. cyanorum* is a riffle form living over gravel and sand bottom. Blue River at the type locality is about 75 feet wide, quite clear, and flows over a riffle created by an outcropping of rock, broken parts of which lie on sand and coarse gravel. Nearer the headwaters the bottom is predominantly fine sand. Darter associates are: *Hadropterus sciera* Swain, *Cottogaster copelandi* (Jordan) (in deeper water below riffle) and *Poecilichthys spectabilis* Aggassiz. In a nearby tributary spring, the new form is in association with *P. spectabilis* and *Microperca microperca* (Jordan and Gilbert).

The name *cyanorum* (= of the Blues), suggested by Dr. R. M. Bailey, refers to the Blue River and its tributary, Little Blue River. The new subspecies is known only from Blue River and its tributaries.

Poecilichthys radiosus paludosus, subsp. nov.

TYPES.—The holotype, UMMZ No. 161368; (Pl. II, Fig. 3), is an adult male 47 mm. in standard length. It was taken by Edgar Leonard, James Stevenson, and Mary Chapman from Bois d'Arc Creek, a tributary of Clear Boggy Creek, in T2N, R6E, Pontotoc Co., Oklahoma, on April 16, 1949. The 221 paratypes bear the following data, with the number of specimens followed by the size range in mm. and the Museum numbers; 58 (30.0–44.5), UMMZ No. 161369, collected with the holotype; 41 (35.5–60.0), and MCZ No. 37205, collected by Moore from Clear Boggy Creek in Pontotoc Co., Oklahoma, April 6, 1947; 19 (28–39), UOMZ No. 26156, collected by John McDowell, Paul White, and Robert Loomis from Jack Fork, Clear Boggy System, T2N, R6E, in Pontotoc Co. south of Ada, Oklahoma, April 16, 1949; 2 (36–41), OAM No. 1703, collected by Joshua Harmon, Paul Gordon, and G. A. Moore from the Kiamichi River south of Talahina, Oklahoma, June 7, 1947. Three collections of paratypes made by A. P. Blair and J. T. Herbelin, from the Kiamichi River and its tributaries, are as follows: 38 (27–38), USNM No. 153533, from a small unnamed tributary in Sec. 17, T2N, R21E, in Pushmataha Co., April 16, 1949; 36 (26-35), UOMZ No. 26157, from Buffalo Creek in T3N, R19E, Latimer Co., 21 miles south of Wilburton April 17, 1949; 27 (30–39), Tulsa University Collections, from Kiamichi River southeast of Clayton in Sec. 7, T1N, R19E, Pushmataha Co., April 16, 1949.

DIAGNOSIS.—This form of *Poecilichthys radiosus*, occurs in the Clear Boggy and Kiamichi systems, and differs from the other subspecies of *radiosus* especially in the color

pattern of the spinous dorsal, which is regularly bordered with a series of blue spots, below which is a faint white band. Below the white band is an orange-red band broken into check marks by virtue of the distal extensions of orange-red on the spines. *P. r. paludosus* is similar in body shape to *P. r. radiosus* but has a blunter snout, which approaches the extremely blunt snout of *P. r. cyanorum*. The background color of *P. r. paludosus* is paler grayish than in the other subspecies.

DESCRIPTION.—A summary of the characteristics of the holotype follows: general body form similar to that of *P. r. cyanorum*, but with slenderer shape and the snout less sharply decurved.

The standard length contains the head length 3.5, the head depth 5.7, the distance from tip of snout to preopercle 2.9, and the length of pectoral fin 4.0 times. The head length contains the head depth 1.6, snout 4.1, eye 3.5, depth of caudal peduncle 2.5, length of upper jaw 3.3, and the distance from tip of mandible to union of gill membranes 1.75 times. The head depth enters the distance from the snout to the edge of the preopercle 1.1, and the eye enters the snout 0.85 times. The genital papilla is pigmented and is much longer than wide (length measured from anus).

The squamation of the holotype is as follows: lateral-line scales 56 (42 pored plus 14 unpored), 7 scales between lateral line and origin of second dorsal and 14 from the lateral line to origin of anal; 21 rows before the dorsal and 28 around the smallest portion of the caudal peduncle; cheeks with exposed scales near the eye, embedded elsewhere; opercles with large exposed scales on the upper posterior border; and nape scales small and exposed except near occiput, where they are embedded.

The fin-ray counts are: D., XI-13; A. II,7; P_1 12-12; P_2 I, 5; and C. 17 (15 branched).

In general aspect the coloration of *P. r. paludosus* is like that of *P. radiosus* as described by Hubbs and Black (1941). On several occasions freshly killed specimens were examined with optical aids and the color characters recorded. In males, the spinous dorsal has a blue border with the pigment confined to 6 (occasionally 7) interradial membranes. The blue (more or less greenish) spots are narrowly margined below by white and are followed proximad by conspicuous orange-red check marks which extend along the spines nearly or quite to their tips. The basal portion of the spinous dorsal is dusky with pale orange areas confined to the membranes. The soft dorsal is narrowly margined with greenish-blue, below which is a very narrow white band, then an orange-red band about as wide as the combined widths of the blue and white. The proximal ends of the fin rays are dusky, and the membranes are suffused with orange and finely speckled with black. The caudal fin is colored like the soft dorsal except that the orange-red band is wider and the base of the caudal is a solid dusky hue. The anal fin is narrowly margined with greenish-blue which is separated from the black-specked, brilliant orange-red base by a very narrow white band. The pelvics are solid greenish-blue, lighter at their borders. The interradial membranes of the pectorals are orange, pale at the fin border. In all males, the gill membranes are orange, and in some specimens the cheeks and opercles are also orange (less intense). The same color is present on the belly and extends upward nearly or quite to the lateral line. In some specimens the orange-red branchiostegal patch encroaches on the isthmus. There is a very limited amount of green on the posterior portion of the breast, which is finely dotted with black.

In females the spinous dorsal has much the same pattern as in the males, except that the colors are less intense, with smaller blue spots (on the first 7 membranes), sometimes encircled by a clear area, immediately below which there is an orange dash. The fin is basally dusky. The last 3 membranes each have a brown instead of a blue spot, but no orange dashes. The soft dorsal is dusky brown, edged with light blue. The caudal is margined with blue, in advance of which is a narrow clear band grading into light brown to dusky, and bears a vertical row of 3 dark spots at its base. The anal is light orange with a pale blue border. The basal two-thirds of the pectorals is yellow, grading to the clear border. The pelvics are clear. The gill membranes are lightly washed with brown and black in alternating lines parallel with the branchiostegals. The breast is finely dotted with black. The sides of the belly are washed dorso-anteriad with diagonal brown dashes. There is a row of 13 dusky blotches just below the lateral line. Those on

the caudal peduncle form indistinct vertical bars. The back is marked with 10 squarish dusky blotches. There are black dashes before, behind, and below the eye; the anterior one approaches, but does not unite with, the one on the opposite side; a small, almost round spot lies in contact with the orbit on the interorbital space. The black head markings are the same in both sexes.

VARIATION.—As in the other subspecies of *P. radiosus*, the new form is subject to considerable variation in body form and coloration. Hubbs and Black (1941) pointed out a variation in color pattern from a mottled to a barred condition in *radiosus*, an observation with which we agree, although their statement that bars were never very conspicuous is true only in the relative sense (Pls. I and II). Wide variability is evident in all measurements and counts (Table I) taken from the paratypes. The anal fin uniformly has two spines in all four forms.

A few males in high breeding color apparently have incipient tubercles, appearing as thickenings on the posterior borders of the belly scales near the anus. Some males, like the holotype (Pl. II, Fig. 3), seem to have a very high and short spinous dorsal, even though the fin-ray count may be average.

In many specimens there is a conspicuous row of saddles on the mid-dorsal line; in others, these blotches are indistinct.

Size is apparently correlated with the size of stream. The maximum sizes in millimeters from various localities are: Clear Boggy, 60; Bois d'Arc, 47; Jack Fork, 39; and Kiamichi and tributaries, 41. Bois d'Arc and Jack Fork, both tributaries of the Clear Boggy, are small streams that in July, August and September have a surface flow only after relatively heavy rains, and support large populations of *P. r. paludosus* which mature at a small size. The larger Clear Boggy, with its continuous flow, supports a smaller population of larger individuals. Our last visit (April 14, 1949) to the Clear Boggy yielded no specimens whereas, two days later, many specimens in breeding condition were taken in Bois d'Arc and Jack Fork.

Rainfall variation from year to year may also influence size attainment. The summer of 1948 was of the usual dry type in Oklahoma, whereas the summer of 1950 was unusually wet. Specimens of maximum size taken from Bois d'Arc and Jack Fork May 5, 1951, measure 59 and 58 mm. respectively.

The genital papilla is highly variable in both sexes. In males it is usually semicircular with a small median pointed projection or with an emarginate posterior edge lacking the pointed tip. Occasionally the papilla is squarish. In females the genital papilla is almost always emarginate with a triangular or roughly square to rectangular shape, occasionally without emarginations. The usually immaculate female papilla occasionally has some black pigment proximally.

SEXUAL DIMORPHISM.—As already indicated for the species, *P. r. paludosus* exhibits considerable differences between the sexes. In addition to the brighter colors of the males, the sexes are easily recognized by their genital papillae, as described above. In males the spinous dorsal is frequently higher than in females (Pl. II, Figs. 3 and 4; Table I).

HABITAT.—This new subspecies inhabits the clear, sandy or gravelly tributaries of Clear Boggy Creek and the Kiamichi River in greater abundance than it does the main streams. Vigorous seining in the Kiamichi near Talahina yielded only two specimens, whereas many were found in small tributaries. Since the river at this location is fairly deep and has a mud bottom, the scarcity of darters there occasioned no surprise. The Clear Boggy near Ada has a sandy bottom with much organic debris. Bois d'Arc and Jack Fork creeks have a bottom of coarse gravel. Percid associates are apparently few. The Blair and Herbelin collections 21 miles south of Wilburton yielded none, and their collections at Clayton contained only 3 specimens of *Microperca proeliaris* Hay. In the Clear Boggy, *P. r. paludosus* is associated with *Hadropterus scierus*, *Poecilichthys spectabilis*, and *Cottogaster copelandi*.

The name *paludosus*, suggested by Dr. Mack Griffin of the Foreign Languages Department, Oklahoma Agricultural and Mechanical College, refers to Clear Boggy Creek where this form was first found.

DISCUSSION

On the basis of pored-scale counts, *P. radiosus* of Little River is clearly differentiated from *P. radiosus* of the Ouachita River, since 78% of the Ouachita sample and 93% from Little

River are identifiable if the break is placed between 40 and 41 pored-scales. Specimens from the Saline River, however, are intermediate. They could be interpreted as intergrades between the typical subspecies of the Ouachita and a possible new subspecies in the Little River System. In spite of this apparently strong indication of differentiation, we prefer to place all *P. radiosus* east of the Kiamichi River in the typical subspecies until a larger sample of specimens has been studied. It is quite possible that the Little River population may prove separable on the basis of pored-scale counts. However, in other characters the populations of *radiosus* in Little, Saline and Ouachita rivers form a very closely related, compact and homogeneous group. Therefore, we feel that nothing would be gained by proposing, at the present time, another name for the series from the Little River System.

We have considered the idea of recognizing *P. r. cyanorum* and *P. r. paludosus* as full species, and, in all probability, some taxonomists would favor that view, since there is no areal intergradation between these forms or between either of them and the typical subspecies, but the similarities in pigmentation, vertebral counts and other meristic characters prompts a rejection of that view. As it stands, *P. radiosus* forms an easily recognizable group of subspecies which, in themselves, indicate a clear example of geographic isolation, with the muddy Red River acting as a barrier to intercommunication between the various populations.

It is significant that *P. r. paludosus* and *P. r. cyanorum* are concentrated in greater numbers in the upper two-thirds of the stream courses, whereas, few specimens occur in the more sluggish portions of the streams near the Red River. Recent collections of fishes from the Red River itself have yielded no darters, other than a single specimen of *Imostoma shumardi* (Girard). Maps show a small creek entering the Red River between the mouths of Blue and Boggy rivers but no collections have been made there; the darter population, if one exists, might be very interesting.

Recent observations on specimens of the species group herein discussed indicate that the assignment of Texas materials to *radiosus* by Hubbs and Black (1941) is erroneous. Collections made by Mr. Joe Raffaelli and Moore from Red River tributaries in Texas yielded no specimens of *radiosus*. Specimens of *P. artesiae* were taken from Barkmans and Aikins creeks in Bowie County. The former is tributary to Red River and the latter is a tributary of Sulphur River, which is also a Red River tributary. Although these specimens have a somewhat different coloration than specimens from Lawrence Creek, 6 mi. N. W. of Marshall, Texas, kindly sent us by Dr. Clark Hubbs, they agree quite well in counts and measurements with the data of Hubbs and Black for *artesiae*.

This discovery of *artesiae* in the Red River System close to but not overlapping the range of *radiosus* constitutes a considerable extension of the known range of *artesiae*. This is particularly interesting since neither form has influenced the other across the main Red River which has acted as an effective barrier to the movements of these small fishes.

Although the distribution and number of red spots on the sides of *P. whipplei* and *P. artesiae* are somewhat different, they both possess this character which is absent in *radiosus*. The forms *artesiae* and *whipplei* are then readily distinguished from *radiosus* and differ from one another particularly on the basis of lateral-line scale counts and fin-ray counts (see Hubbs and Black, 1941; Tables I and IV). For these reasons and since the ranges of *artesiae* and *whipplei* are separated by that that of *radiosus*, now indicated to be specifically distinct, it is difficult to regard *artesiae* as a subspecies of *whipplei*. It seems highly probable that a thorough study of *artesiae* might even show this form to be subspecifically divisable.

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Jumping Ability of Certain Anurans, with Notes on Endurance

A. STANLEY RAND

ALTHOUGH frog-jumping contests periodically receive newspaper publicity, no study has been made, apparently, of the leaping ability of salientians from the standpoint of species involved, size, proportions and habits. The only data on the length of frog jumps that I have found are scattered through accounts of individual species (Pope, 1944; Wright and Wright, 1933; Dickerson, 1906).

Observations were made in nature and experiments were conducted on *Bufo woodhousei fowleri*, *Acris crepitans*, *Hyla crucifer*, *Rana clamitans*, *Rana pipiens* and *Rana catesbeiana*. All work was done at Chesterton, Indiana, and vicinity.

I wish to express my thanks to Dr. A. L. Rand for his assistance throughout this work; to Mr. K. P. Schmidt and Mr. C. H. Pope for reading this manuscript and for their helpful suggestions.

In the experiments, the usual practice was to make the frogs hop on a grassy lawn but sometimes a smooth floor was utilized. With few exceptions the experiments were conducted on the day of capture or the day following. The frogs were usually stimulated to jump by a movement of my hand in their direction; sometimes it was necessary to touch the animals, but prodding was rarely resorted to. After each leap, the place where the frog landed was marked and the frog was then stimulated to jump again. Sometimes a frog would make successive leaps after only one stimulus.

Ten series, each composed of ten leaps, were recorded for every species. Usually, individuals were used more than once, but only after a rest period of three minutes between stimuli. The reliability of the experiments was checked by comparing the results with those observed in nature, and it was found that they were usually in substantial agreement. The results also compared favorably with the few published data. However, the nature of the surface is apparently correlated with the length of the jump. Fowler's toad, for example, achieved greater distances on grass than it did on sand.

Various measurements, actual and comparative, were made. Body length was measured from the tip of the snout to the vent (BL), and leg length from the tip of the longest toe to the vent (LL). The relative length of leg (RLL) is the number of millmeters of leg length per millimeter of body length. The average length of jump (ALJ) is the average of the totals of the greatest leaps in each of the ten series. The relative length of jump (RLJ), obtained by dividing ALJ by the average BL, is the number of millimeters jumped per millimeter of body length.

OBSERVATIONS AND EXPERIMENTS

Bufo woodhousei fowleri Hinckley. Tracks in the sand indicate that Fowler's toad may travel considerable distances and that it normally covers from 125 to 150 mm. per hop.

Three toads captured and released in an area of bare sand made jumps ranging from 150 to 375 mm. In experiments conducted on a grassy lawn, four toads jumped distances varying from 300 to 575 mm. (Table I). Since the distances covered on the grass are greater than those on the sand, it may be that

these toads are not able, ordinarily, to jump so far in their natural habitat as they can under different surface conditions.

Six frogs, found in the vegetation bordering a pond, made jumps ranging from 412 to 975 mm. on the adjoining exposed mudflat; seven

TABLE I

JUMPING ABILITY OF FOWLER'S TOAD

On Sand			On Grass		
Individual	Average length of consecutive jumps	Range	Individual	Average length of 10 consecutive jumps	Range
A	239 (30 jumps on level)	175–312	A	475	362–525
			A	446	375–500
B	226 (20 jumps up hill)	150–262	A	390	337–437
			B	486	425–550
C	319 (20 jumps down hill; 10 jumps up hill)	225–375	B	452	425–475
			B	344	300–412
			C	520	375–575
			C	505	400–575
			D	505	437–550
			D	412	325–487

TABLE II

JUMPING ABILITY OF THE CRICKETFROG

On damp mud flat			On smooth floor		
Individual	Average length of consecutive jumps	Range	Individual	Average length of 10 consecutive jumps	Range
A	622 (5 jumps)	437–850	A	619	462–687
B	737 (16 jumps)	412–975	A	626	475–775
C	700 (2 jumps)	625–775	B	892	675–1037
D	700 (2 jumps)	625–775	B	741	475–950
E	662 (2 jumps)	600–725	C	881	600–1050
F	700 (4 jumps)	650–750	D	715	675–850
			D	659	325–925
			E	637	400–837
			F	621	500–712
			G	625	425–800

The average measurements and comparative data of the four toads used in the experiment on grass were: BL, 64.8 mm.; LL, 82 mm.; RLL, 1.27; RLJ, 7.8; ALJ, 509 mm.

This species differed from most others tested in that it tended to make series of leaps after a single stimulation.

Acris crepitans Baird. Wright (1933: 81) said that cricketfrog males "jump 3 feet (900 mm.) at a time on the water's surface"; Pope (1944: 89) stated that "As a jumper the cricket frog has astonishing proficiency, making leaps of 3 to 4 feet (900–1200 mm.)."

frogs made jumps varying from 325 to 1050 mm. in experiments conducted on a bare floor (Table II).

The measurements and comparative data of the frogs used in the experiments on the bare floor were: BL, 21–26 mm. (23.8); LL, 36–44 mm. (38.8); RLL, 1.63; RLJ, 36.2; ALJ, 862 mm.

Hyla crucifer Wied. At night on the breeding ponds the spring peeper did not jump readily. Individuals, when touched, would leap from 50 to 175 mm. to another position, or would enter the water with jumps ranging from 137

to 175 mm. On the forest floor in mid-September four peepers made jumps ranging from 300 to 375 mm. (estimates). In experiments conducted on a smooth floor four frogs made leaps ranging from 62 to 525 mm. (Table III).

The measurements and comparative data of the frogs induced to jump on the bare floor were: BL, 24–28 mm. (24.7); LL, 34–44 mm. (37.3); RLL, 1.5; RLJ, 17.9; ALJ, 442 mm.

After the first few leaps the frogs had to be touched or even prodded to make them continue the performance.

Rana clamitans Latreille. No data were secured on the leaping ability of the greenfrog in its natural habitat. In experiments conducted on a grassy lawn, five frogs made jumps ranging from 400 to 830 mm. (Table IV).

The measurements and comparative data of the frogs used in the experiments were: BL, 69–75 mm. (72.4); LL, 108–114 mm. (111.2); RLL, 1.54; RLJ, 11.5; ALJ, 830 mm.

Rana pipiens Schreber. One leopardfrog, observed in its natural habitat, made jumps of 825, 850 and 775 mm. on a mud flat. Five frogs, induced to jump on a grassy surface, made leaps ranging from 525 to 1125 mm. (Table IV).

The measurements and comparative data of the frogs observed on the grassy surface were: BL, 62–83 mm. (72.8); LL, 123–140 mm. (126.8); RLL, 1.74; RLJ, 12.9; ALJ, 937 mm.

Rana catesbeiana Shaw. Dickerson (1906) said that the bullfrog proceeds across county "by successive leaps, about three feet each in length. He can cover a distance of five or six feet without difficulty, notwithstanding his large, heavy body." In experiments performed on a grassy surface, five immature bullfrogs made jumps ranging from 175 to 962 mm. (Table IV).

The measurements and comparative data of the frogs used in the experiments were: BL, 67–87 mm. (76.2); LL, 106–130 mm. (118.2); RLL, 1.54; RLJ, 8.9; ALJ, 682 mm.

If the assumption is correct that Dickerson (*loc. cit.*, and p. 228) meant that bullfrogs 7 or 8 inches in length can make leaps of 5 or 6 feet, the RLJ of mature individuals is between 9 and 10, a figure very close to the one recorded above (8.9) for immature ones.

Insofar as habitat is concerned, the terrestrial-semi-aquatic cricketfrog has the highest relative length of jump, the arboreal peeper an intermediate one, and the terrestrial Fowler's toad the lowest. From the standpoint of body length the small cricketfrog has the highest RLJ, the small peeper has an intermediate one, the medium-sized Fowler's toad has the lowest, and the large leopardfrog, greenfrog and bullfrog have a low one. The species with the lowest RLL, Fowler's toad, also has the lowest RLJ; the cricketfrog, with a more or less intermediate RLL, has the highest RLJ; the leopardfrog, with the highest RLL of all species tested, has a low RLJ. From a systematic viewpoint the hylids, which are also the smallest, have the highest RLJ;

TABLE III

JUMPING ABILITY OF THE SPRING PEEPER

At breeding pond			On smooth floor		
Individual	Average length of consecutive jumps	Range	Individual	Average length of 10 consecutive jumps	Range
A	94 (2 jumps)	87–100	A	381	300–500
B	113 (2 jumps)	100–125	A	337	225–525
C	113 (2 jumps)	50–175	A	335	225–450
D	58 (3 jumps)	50–75	B	299	175–462
E	287 (1 jump)	...	B	301	125–475
F	137 (1 jump)	...	B	231	100–350
G	100 (5 jumps)	50–175	C	277	75–387
H	269 (2 jumps)	237–300	C	211	62–450
			D	310	212–450
			D	281	225–375

the bufonid, medium-sized, has the lowest; the ranids, the largest, have a low RLJ (Table V).

TABLE IV

RANGE AND AVERAGE LENGTH OF 10 CONSECUTIVE JUMPS OF THE GREENFROG, LEOPARDFROG AND BULLFROG ON GRASS

Individual	Greenfrog		Leopardfrog		Bullfrog	
	Range	Average	Range	Average	Range	Average
A	400–775	592	637–1125	887	625–962	760
A	425–765	529	612–1025	762	375–750	574
B	712–1075	929	712–912	812	325–725	592
B	500–1025	695	600–825	715	387–612	506
C	600–837	756	775–1025	885	237–500	444
C	450–912	651	625–850	776	375–675	491
D	500–900	729	762–1012	891	450–675	579
D	400–675	576	500–675	612	337–675	546
E	550–750	654	525–1000	724	200–600	396
E	375–675	544	725–925	786	175–650	540

TABLE V

JUMPING ABILITY OF SIX SPECIES OF SALIENTIANS IN RELATION TO SIZE, RELATIVE LENGTH OF LEG, AND HABITAT

Species	Habitat	BL	RLL	Range in Exper.	ALJ with σ	RLJ	Range in nature
Cricketfrog	Terrestrial, semi-aquatic	23.8	1.63	325–1050	862 (119)	36.2	550–975
Spring Peeper	Arboreal	24.7	1.51	62–525	442 (52)	17.9	50–300
Fowler's Toad	Terrestrial	64.8	1.27	300–575	509 (53)	7.8	150–375
Greenfrog	Aquatic, semi-aquatic	72.4	1.54	400–1075	830 (138)	11.5	no data
Leopardfrog	Terrestrial, semi-aquatic	72.8	1.74	525–1125	937 (123)	12.9	825–850
Bullfrog	Aquatic	76.2	1.54	176–962	682 (115)	8.9	no data

OBSERVATIONS ON ENDURANCE

During the course of the above study, data were accumulated on the number of times individuals of certain species could be induced to jump.

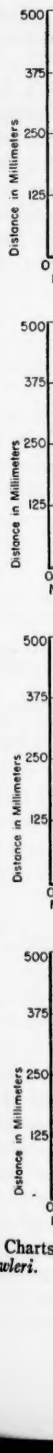
Hyla crucifer Wied. A freshly caught adult released on a grassy lawn made 120 jumps (Chart 1), and another made two series of leaps composed of 43 and 44 jumps, respectively, with a five minute rest period in between (Chart 2).

After the first few jumps, both frogs had to be touched or prodded to induce them to continue. Occasionally one would try to get under the grass, perhaps an escape reaction, a fatigue response, or a combination of the two.

Acris crepitans Baird. One adult cricketfrog was startled in the wild on the moist mud border of a drying pond. It jumped rapidly throughout the series, but after about 15 leaps of normal length the distance covered grew less and less, eventually amounting to no more than 50 mm. Finally, the frog would jump no more (Chart 3).

Pseudacris nigrita triseriata (Wied). An adult chorusfrog on a grassy lawn made a series of 13 jumps and, after an interval of about two minutes, made another of 31 (Chart 4). After the first few leaps in each series the frog did not jump readily and often attempted to crawl beneath the grass blades.

Bufo woodhousei fowleri Hinckley. Three toads released on the sand jumped readily, without stimulation by touch. One toad made 20 leaps and the other two made 30 each. There was little decrease in length of jump at the end of the series, except when one toad turned and began to go uphill (Chart 5).



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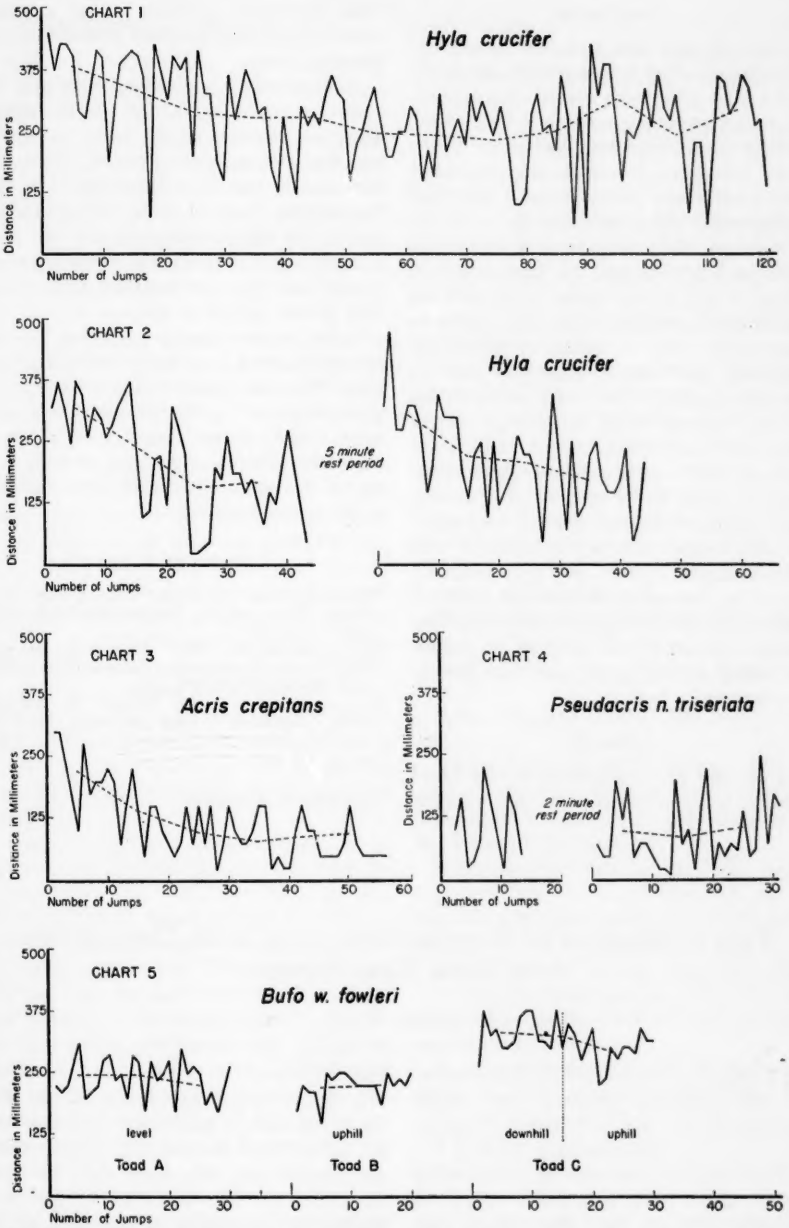

Charts 1–5. Jumping endurance of *Hyla crucifer*, *Acris crepitans*, *Pseudacris n. triseriata* and *Bufo w. fowleri*.

Discussion

Although both long and short leaps were characteristic of all species studied, the length of the jump of the toads was the most uniform. The spring peeper progressed with long jumps, with occasional short ones interspersed in the series (Chart 1); the chorusfrog progressed with short jumps, with occasional long ones interspersed in the series (Chart 4).

The shape of the curve for each species was determined by averaging the jump lengths in groups of ten. In the spring peeper and the cricketfrog the average length of jump became progressively less, a situation presumably correlated with fatigue (Charts 2 and 3). The spring peeper, after a rest period of five minutes, jumped nearly as strongly in the second series as it did in the first. In the toads there was only a slight decrease in the average length of jump in the series of 30. This may have been due to the fact that they were utilizing their normal mode of progression in their normal habitat (Chart 5). The chorusfrog showed no decrease in the average length of jump in the series of 30 (Chart 4). This was perhaps correlated with its great propensity for hiding in the grass and consequently obtaining short rests.

Summary

In six species of salientians it was found that size is not correlated with the actual distance covered by jumping but, to a certain extent, is correlated inversely with the relative length of jump.

Jumping ability is correlated with both the relative length of the hind legs and the habitat. The most aquatic species have moderately long legs and moderate jumping ability; the semi-aquatic ones have the longest legs and the greatest jumping ability; the terrestrial species has the shortest legs and the least jumping ability; the arboreal species has moderately long legs, a short actual jump, but a high relative length of jump.

In four species tested it was found that the endurance factor in jumping varied considerably. There was considerable variation in the distance covered in the individual leaps of a series, but the terrestrial species was the most consistent. During short rest periods two species of frogs regained their former jumping ability almost completely.

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Two Collections of Reptiles from Iraq, with Descriptions of Two New Forms

Georg Haas

My colleagues, Professor F. S. Bodenheimer and Prof. O. Theodor, have kindly presented to me two collections of reptiles from Iraq. Prof. Bodenheimer's material was collected in 1943 in the vicinity of Mossul, at Addaye, 40 km. to the west, and Dr. Theodor's collection, May to July 1928, comes from Baghdad. I have had the opportunity to discuss the problems presented in identifying the specimens in these collections, with my colleague, Mr. Karl P. Schmidt, on the occasion of a visit to the Chicago Natural History Museum, and wish to express my thanks to him and to the two collectors. The collectors could not provide me with exact data for their specimens. As the collection is—*par force majeure*—not accessible to me, some of the data are incomplete. The material in question, in the Hebrew University collection, includes the following species.

Stenodactylus grandiceps, sp. nov.

TYPE.—An adult female from Addaye, 40 km. west of Mossul, collected by F. S. Bodenheimer.

DIAGNOSIS.—A *Stenodactylus* with dorsal scales keeled, a relatively large and broad head, and a relatively short tail.

DESCRIPTION OF TYPE.—Habitus (compared with *Stenodactylus sthenodactylus*) stout, with limbs and tail relatively short; tail swollen at base, then gradually tapering; head heart-shaped, with blunt snout, sharply set off from neck, with swollen temporal region; head in profile slightly convex without a bulge in the ocular region; nostrils close together; rostral cleft half its height; nostril between rostral, first labial, and three nasals; inner nasals broadly in contact; upper labials 10, lower labials 9; no postmentals; head scales rugose, larger than those of the back, 25 in a transverse series at the posterior angles of the eyes; dorsal scales subimbricate and keeled; gular scales granular; three enlarged conical tubercles on each side of the root of the tail forming an uninterrupted oblique series; scales of upper sides of limbs strongly keeled; no preanal or femoral pores; irregular white spots on forehead and back and on dorsal side of limbs; whitish beneath. Measurements of type: snout to vent 57 mm.; tail 31; head to posterior border of tympanum 15; width of head 12.5.

COMPARISONS.—The measurements of a specimen of *Stenodactylus sthenodactylus* in our collection (No. 1557) are: snout to vent 52.5 mm., tail 38, length of head 14, width of head 11. There is always a small scale behind the rostral and between the nasals in *S. sthenodactylus*, and the upper labials are 11; also the eyes form a considerable bulge in the profile of the head, contrasting with the smooth curve of *S. grandiceps*. In *S. sthenodactylus* the nostrils are more widely separated; the dorsal scales are smooth, and the keels of the scales on the upper sides of the limbs are less sharply raised.

NOTES ON PARATYPES.—The male paratype in our collection has no preanal or femoral pores; the three tubercles at the base of the tail are more prominent than in the female. The measurements and other data for this specimen and for four specimens from Rutba in the Chicago Natural History Museum (Nos. 19676–19679, recorded by Schmidt (1939) as *Stenodactylus sthenodactylus*) are as follows:

	Hebr. Univ. 1506♂	CNHM 19679♂	CNHM 19676♂	CNHM 19678♀	CNHM 19677♀
Total L.	90.5	83.0	64.0	82.7	85.0
Tail L.	38.0	31.0	23.5	31.0	31.0
W. head	11.0	11.7	9.7	11.5	12.0
L. head	14.0	15.0	11.5	14.3	14.3

Gymnodactylus scaber Heyden. Ten specimens from Baghdad.

Hemidactylus persicus Anderson. Three specimens from Baghdad, one from Addaye. This species has been recorded from Iraq by Procter (1921). The Addaye specimen differs somewhat from the ones from Baghdad, which agree with Boulenger's description. The rostral is not fused with the first labials, and the number of upper labials is 13, as compared with 10–11, lower labials 10 as compared with 9; 9 instead of 8 preanal pores.

Hemidactylus flaviviridis Rueppell. One from Baghdad; one from Addaye.

Phyllodactylus eliasae Werner. Seven from Baghdad.

Agama ruderata Olivier. Two males from Addaye.

Acanthodactylus grandis Boulenger. One from Addaye. Snout to vent 101 mm., tail 160. The subocular borders the mouth between the 4th and 5th supralabials.

Acanthodactylus tristrami orientalis Angel. Two males and one female from Addaye. All have 48 or 49 scales around the middle of the body.

Ophiops elegans persicus Boulenger. Four from Addaye. These specimens have the collar well developed and free, and 31 to 36 scales around the body.

Apathya cappadocica Werner. A single male from Amadiyeh, Iraqui-Turkish border. The color pattern agrees with *A. c. urmiana* (Lantz and Suchow, 1934), whereas other characters point rather to *A. c. wolteri* (Bird, 1936). Its measurements are snout to vent 68 mm., tail 152 mm. Occipital much broader than parietal, but slightly shorter; supraoculars in order of size 1-4-3-2; first supraocular excluded from contact with the frontal; superciliaries 6-7, superciliary granules 16-17; semitrans-

parent plates in eyelid 7; 5 upper labials anterior to subocular; lower labials 7; chin shields 5 pairs, first 3 in contact; no masseteric shield; 2 postnasals, with a minute scale behind the lower one on the right; a small subnasal excluding the rostral from the nostril; 2 supratemporals, first very long and slender, second twice as long as broad, two-thirds longer than first; a small elongate tympanal; 29 gular scales from collar to chin shields; 13 scales in collar; collar crenelated, each scale with an arched border; 64 dorsal scales across middle of body; ventrals in 8 longitudinal and 26 transverse series; femoral pores 22-23; subdigital lamellae under 4th toe 26.

Dorsum with 6 rows of partly fused black spots; the two median series extending from the 2nd supraocular as interrupted and irregular stripes, which disappear at the level of the forelimbs; upper of the lateral pair of stripes originating at the superciliary granules, forming black lines; lower black lines beginning at the upper posterior corner of the subocular; space between the lateral stripes brown on anterior third of body; black spots of the lines forming a mottled reticulum, with three bright blue ocelli on each side of the body; all three pairs of stripes continued as series of black dots on the anterior third of the tail; three lateral longitudinal rows of ventrals with black dots; upper sides of limbs with black reticulation; mid-back brown anteriorly; general ground color, except as noted, faintly bluish gray.

Mabuya aurata septemlaeniata Eichwald. Three from Addaye. In these specimens the four black dorsal lines are more sharply defined than in the one figured by Mertens (1924).

Eumeces schneideri princeps Eichwald. Two from Addaye.

Lytorhynchus diadema mesopotamicus subsp. nov.

TYPE.—An example, sex unknown, from Addaye, collected by F. S. Bodenheimer.

DIAGNOSIS.—A subspecies differing from other forms of the species in number and length of dorsal transverse blotches.

DESCRIPTION OF TYPE.—Habitus of *Lytorhynchus d. diadema*; rostral broad, not concave above; dorsal scales in 19 rows; ventrals 173; caudals 39; anal divided; upper labials 8-8, lower labials 10-10; a single vertical preocular, in contact with the subocular, which is above the fourth upper labial; 2 postoculars; loreal trapezoid; frontal elongate, longer than its distance from the end of the snout.

A median row of large dark blotches on the back, with two rows of alternating spots on the sides; 31 dorsal blotches on the body and 9 on the tail, each extending over about 5 dorsal scales, separated by interspaces of 2 scales; frontal and nuchal markings as in *L. d. diadema*.

MEASUREMENTS.—Not available (see first paragraph).

COMPARISONS.—The difference between this subspecies and *Lytorhynchus d. kennedyi* Schmidt, from between Homs and Palmyra, Syria, is most evident in the color pattern, since in *L. d. kennedyi* the dorsal blotches are much narrower than the interspaces, the reverse of the arrangement in *L. d. mesopotamicus*. In *L. d. diadema* from Palestine the blotches are more widely spaced, and are thus intermediate between the condition in *kennedyi* and *mesopotamicus*. *Lytorhynchus d. arabicus* is more slender in habitus and has about 50 dorsal blotches on the body. It is proposed, pending further review of the genus, that these four forms be placed as subspecies of *L. diadema*.

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The Herpetology of Tiber Reservoir Area, Montana

James E. Mosimann and George B. Rabb

LITTLE herpetological work has been done in north-central Montana. There is no recent publication on the reptiles and amphibians of the state as a whole. Coues and Yarrow (1878) have published on the herpetology of Dakota and Montana Territories, but most work has been concentrated in the mountainous western part of the state (e.g., Brunson and Demaree, 1951).

During the summer of 1950, while with an archaeological party of the Smithsonian Institution's Missouri River Basin Surveys at the site of the proposed Tiber Reservoir in Toole and Liberty counties, Montana, we found opportunity to make observations on the reptiles and amphibians of the area. From June 13 to August 26, we camped in the reservoir area at Turner Memorial Park, an infrequently used picnic ground on the south bank of the Marias River, in Toole County, approximately 10 miles south of Galata.

The Tiber Reservoir area is located on the Marias River about 50 miles from its junction with the Missouri. The proposed reservoir lies in the Northern Great Plains about 100 miles east of the eastern edge of the Northern Rocky Mountains. Its altitude varies from about 2,900 feet at the river to a little over 3,020 feet on the prairie.

The habitat of the reservoir area may be divided into three main types: river valley, coulees, and prairie. The river valley was roughly divisible into two areas, flood plain and slightly higher land. The flood plain often supported sizeable stands of cottonwoods (*Populus*), which were the only large trees in the entire area, and dense covers of brush, mainly gooseberry (*Grossularia*) and willow (*Salix*), but also blueberry (*Vaccinium*) and wild cherry (*Prunus*). The higher land lacked woody plants for the most part; much of its area served as cattle pasturage and also, in places, for the cultivation of alfalfa and wheat. Sagebrush (*Artemisia*) was conspicuous on the grazed portions of this higher ground. The width of the valley in the reservoir area varied from about one-third to slightly over one mile.

The coulees were numerous, small, narrow "valleys" or gullies bordering on the valley, and opening into it at approximate right angles. These gullies were characterized throughout most of their lengths by steep sides not uncommonly 100 feet high. These sides often had broad exposures of undifferentiated Cretaceous Colorado shale, which as a rule were devoid of vegetation. Elsewhere grasses formed the main cover, although in places a species of cedar (*Juniperus*) formed a low matted growth over wide areas of the coulee walls. Sagebrush and prickly pear cactus (*Opuntia*) often grew on the sides, especially near the tops of the ridges. The coulees formed a strip bordering the river valley on each side. The separate widths of these strips varied from about a half-mile to a matter of feet where the meandering river had caused considerable erosion and had formed bluffs.

The prairie of the reservoir area consisted mostly of low grasses usually forming a sod-like cover. The prairie may be referred to the short-grass climax (Larson, 1940). A large part was cultivated, mainly for wheat, and sagebrush was conspicuous on cattle-grazed areas as in the river valley. Notable in connection with the prairie habitat were small artificial cattle-ponds. The water-surface area of one on July 18 was about 300 square feet. Some dried completely during the summer, but others were permanent enough to support aquatic plants in numbers and held water throughout the drying season. Except for occasional rain puddles, these ponds formed the only standing water on the prairie of this region.

Since the archaeological work was confined to the river valley, collecting preference was unavoidably given this habitat, although all three habitats were regularly worked.

A collection of 108 amphibians and 15 reptiles, representing 11 species, was made. This has been deposited in the Charleston Museum, Charleston, South Carolina, lot number ChM 50.148. Considering the two and one-half months of time in the field, and the fact that our primary interests were in the reptiles and amphibians of the region, we feel that the smallness of the collection is indicative of

the poverty of the herpetological fauna of the area. There follows an annotated list of the species observed in the area.

Scaphiopus hammondi bombifrons (Cope). Four specimens: ChM No. 50.148.24, —.34 (3). Spadefoots were regularly looked for, but were collected only twice, and heard on only three days: July 2, August 6, and August 7. Heavy rains had preceded each of these three chorus dates. An individual was taken actively hopping on dry flood plain at the campsite on the night of July 21 by W. D. Enger. There had been no rain immediately before this date. Three specimens of *Scaphiopus* were collected from a chorus on August 6 following heavy rains. In this chorus, and in a weaker one on the following night (August 7), spadefoots were singing from rain pools varying from a few inches to over a foot in depth, situated in the river valley at the wide flat-bottomed lower ends of the coulees. In the vicinity of these pools, sagebrush and grasses formed the main vegetation. This area was normally dry, and searches here previous to August 6 had revealed neither spadefoots nor signs of their presence. The four specimens obtained were identified by Dr. C. F. Walker. To our knowledge this constitutes the northwesternmost record of this form.

Bufo cognatus (Say). Eight specimens: ChM No. 50.148.20, —.25 (7). This species was collected twice in July, each time at the same locality, an artificial cattle-pond on the prairie approximately a mile south of camp in Toole County. All except one of fifteen individuals taken were collected at night. Two of three females secured on July 20 contained well-developed eggs. These toads were not heard to call during the entire field period.

Pseudacris nigrita. Seventy-four specimens: ChM No. 50.148.2, —.3, —.6 (8), —.14 (14), —.15 (20), —.16, —.19 (16), —.21 (13). This was the most common amphibian in the summer's experience. It was observed in the river valley, in the coulees, and on the prairie. Large numbers of immature and recently transformed chorus frogs were commonly seen in and around artificial ponds on the prairie. Five series of newly transformed frogs were taken. Snout-vent measurements were made in mid-September after one to two months preservation in formaldehyde (Table I).

TABLE I

TRANSFORMATION SIZES OF FIVE SERIES OF *Pseudacris nigrita*

ChM No.	N	Snout-vent length (mm.) $M \pm \sigma_e$	O-R	$\sigma \pm \sigma_\sigma$	Date collected	Remarks
50.148.6	8	12.6 ± .26	12–14	0.74 ± .19	Aug. 13	6 with tail stubs, 2 without.
50.148.14	14	19.0 ± .23	18–21	0.88 ± .17	July 10	10 with tail stubs, 4 without.
50.148.15	20	18.4 ± .17	18–20	0.77 ± .12	July 12	18 with tail stubs, 2 without.
50.148.19	8	12.7 ± .47	11–14	1.34 ± .33	July 16	None with tail stubs.
50.148.21	13	16.0 ± .33	14–18	1.18 ± .23	July 18	4 with tail stubs, 9 without.

The July 10, 12, and 18 series were taken from two dammed prairie ponds, one the *Bufo cognatus* locality, and the other across the river from, and about a mile north of camp. Both of these ponds evidently contained water throughout the year as indicated by the water level in July and August. Each possessed various aquatic plants in fair numbers, and the snail *Lymnea palustris* was abundant.

The locality of the July 16 series was about 5 miles eastsoutheast of camp in Liberty County. Here the frogs were taken about small, drying and dried puddles in the coulees. Although *Juncus* was present, attesting to dampness, these puddles were by no means permanent. Considering the lack of tail stubs and the relatively high standard deviation in body length, the frogs in this series probably do not represent immediate transformation size as well as do the others. Nevertheless the fact remains that they are smaller than frogs in the series taken on July 10, 12, and 18.

The August 13 specimens were taken outside of the reservoir area near Shelby in Toole County. The habitat here was again that of a permanent artificial prairie pond. The edges of this pond apparently had dried rapidly, leaving behind small, isolated drying puddles

of water. It was around these that *Pseudacris* was seen and collected. Although the two ponds concerned in the July 10, 12, and 18 series also displayed a fair amount of drying about their margins, in both the drying was such as to leave no isolated puddles as were left at the Shelby pond. These three series have a larger transformation size than those of July 16 and August 13.

Wright and Wright (1949) under *Pseudacris n. septentrionalis* state, "In Montana at the Crow Agency M. A. Hanna secured a similar set 16–18 mm. on July 11, 1916. All these must be well beyond transformation size, for three out of the five *nigrita* subspecies we know transform at 7.5–13 mm." That *P. nigrita* in the Tiber Reservoir area may transform at a size larger than that given by Wright and Wright is shown by the listed series. However, under apparently unfavorable conditions *P. nigrita* in this area may transform at a size in conformance with the Wrights' statement.

On July 12 the larva of a predacious diving beetle (*Dytiscus*) was seen feeding on a just-transformed chorus frog in a prairie pond near the campsite. Both *P. nigrita* and adult diving beetles were abundant here, and it is possible that these frogs form a common source of food for *Dytiscus*. The larva and frog are preserved, ChM No. 50.148.16.

Ten adult and sub-adult specimens of *Pseudacris* have been examined by Dr. C. F. Walker and are regarded by him as intergrades between *P. n. triseriata* and *P. n. septentrionalis*.

Rana pipiens Schreber. Twenty-two specimens: ChM No. 50.148.1, —.4, —.5, —.7, —.22, —.28 (2), —.29 (15). This frog was found fairly commonly during the summer; all of the individuals observed were in the river valley habitat. This latter fact may have been due to unevenly distributed collecting; nevertheless, none was noted at the prairie cattle-ponds. Adult specimens collected appeared mainly solitary and were found in the vicinity of water. An 85-mm. female taken on July 3 contained well-developed eggs, apparently ready for laying. A June 13 specimen had relatively undeveloped eggs, while one caught on July 25 had eggs intermediate in degree of maturation between the two preceding. A series of 15 just-transformed frogs was taken on July 26 from pools of an intermittent stream in Liberty County about six miles west of camp. Snout-vent measurements were taken about one month after preservation in formaldehyde. For this series (8 individuals with small tail stubs, 7 with the stub apparently just absorbed) $M = 29.9 \pm .37$ mm. and $\sigma = 1.42 \pm .26$ mm.

Phrynosoma douglassi brevirostre (Girard). Three specimens: ChM No. 50.148.12, —.13, —.32. Horned toads were taken twice along the tops of ridges between the coulees, in situations featuring sparsely growing grass, sagebrush, sun-baked soil, and glacial rocks. The lizards were active under a hot sun. Stomach and intestinal contents of the three were examined, although no exact analysis of percentage by volume was made. A 53-mm. (snout-vent) individual contained mostly ants, and also remains of one beetle and a grasshopper. A 39-mm. individual also contained mostly ant-remains plus one spider. These lizards are referred to *P. d. brevirostre* mainly on the basis of range.

Heterodon nasicus nasicus Baird and Girard. Two specimens: ChM No. 50.148.23, —.31. This species is locally called the "snub-nosed viper." A female containing seven eggs of laying size was taken by Phillip Harvey in a cottonwood flood plain at the campsite on July 20. Another female was collected in a coulee about a mile southeast of camp on August 2. The stomachs of both were empty. There is apparently little specific information on *H. nasicus* simulating death. G. E. Hudson in Nebraska (1942: 51) found that "None of the live specimens captured put on any such show as the 'playing possum' act of the eastern species [*H. platyrhinos*]." However, W. J. Breckenridge in Minnesota (1944: 113) mentions this species as having the habit of playing possum characteristic of the eastern hog-nosed snake. Both of the reservoir individuals contorted, turned ventral sides up, lolled their tongues, and became motionless. The second one taken continued motionless when hung over the taillight of a parked truck, and house flies were attracted to her head and mouth. She remained still while one fly crawled in and about her gaping mouth, but closed it when three flies entered. The attraction of flies, possibly by regurgitated food (Lydekker, Cunningham, Boulenger, and Thomson, 1912: 155), seems to be the ultimate in the "simulation" of death by *Heterodon*. This death reac-

tion in *H. simus, platyrhinos,* and *nasicus* has no apparent survival value and may be similar to the reported condition of shock in the opossum (Cahalane, 1947: 106). Hulme (1951) gives a like opinion on this phenomenon in the ringhals cobra (*Hemachatus haemachatus*) and also in *Heterodon.*

Pituophis catenifer sayi (Schlegel). One specimen: ChM No. 50.148.17. The bullsnake was the most common reptile. Six shed skins of this species were noted, and six snakes were either collected or observed. Of these twelve records, nine were from the river valley, one from the coulees, and two from the prairie.

Coluber constrictor flaviventris (Say). One specimen: ChM No. 50.148.11. One blue racer was collected on July 26 in a coulee just north of camp. While being preserved, this specimen regurgitated several grasshoppers. The stomach contained remains of about three more. Murrel Robertson, a reliable observer, has not seen this species in the area. Apparently it is not common. No other individuals were seen, but two shed skins were found in the coulee habitat.

Thamnophis elegans vagrans (Baird and Girard). Five specimens: ChM No. 50.148.8, —.9, —.10, —.27, —.30. Five were taken, all from the same locality in Liberty County about six miles west of camp. These snakes were collected in early and late July along the edges of pools formed in the bed of an intermittent stream winding through a wooded portion of the river valley. Bordering the stream bed here was a dense understory of gooseberry and willow topped by cottonwoods. Leopard frogs were commonly seen in and about the pools, which had rushes (*Juncus*) and cattails (*Typha*) growing about the edges, and various aquatic plants (*Sagittaria* and others) in the pools themselves. The stomachs of all five were empty. These snakes are typical examples of *T. e. vagrans.*

Thamnophis radix haydeni (Kennicott). One specimen: ChM No. 50.148.18. An individual was taken on the margin of a cattle-pond on brushless rolling plains about 1.5 miles south of camp on July 16. The specimen, a female, is referable to *T. r. haydeni* as reproposed by A. G. Smith (1949). Scale rows 21-21-17; ventrals 166; subcaudals 66 (tip of tail missing); upper labials, left 7, right 8; total length 748 mm.; tail length 159 mm.

Crotalus viridis viridis (Rafinesque). Two specimens: ChM No. 50.148.26, —.33 (head only). This rattlesnake was encountered five times. Three were found dead on U. S. Highway No. 2 in prairie habitat outside of the reservoir area, and two were collected in river valley situations in the area. An individual swimming in the Marias River was taken on July 24. The following are reliable local reports. Thomas Bretz and Kenneth Holmes roughly restrict the rattlesnake to prairie habitat. Other reports tend to confirm this; however, Murrel Robertson states that from about August 1 to September 1 there is a tendency for snakes (e.g., the rattlers) to move down into the river valley. Of three stomachs examined, one was empty, a second contained two, and a third at least one adult-sized *Peromyscus maniculatus artemisiae.* A fourth individual, alive at the time of writing, egested hairs of the same color and texture as those of this mouse, which was abundant at the campsite and was commonly collected elsewhere.

In summary, a period of ten and one-half weeks was spent in the field at the site of the proposed Tiber Reservoir in Toole and Liberty counties, Montana. Four species of amphibians and seven of reptiles were collected. Notes were made on the life-histories of some. The area is thought to support a limited herpetofauna.

Thanks are due to the following: W. D. Enger, archaeologist in charge, for his consideration and aid; Phillip Harvey, G. S. Krantz, and W. R. Wood for aid in collecting; Kenneth Holmes and Thomas Bretz of the United States Geological Survey and Murrel Robertson, farmer of Devon, for information on local fauna; Dr. C. F. Walker of the Museum of Zoology, University of Michigan, for the subspecific determination of *Scaphiopus* and *Pseudacris.* The data on altitude and other information regarding the width of the river valley and of the coulee strips were taken from a map of the Tiber Dam Reservoir Area, Bureau of Reclamation, United States Department of the Interior. This paper is a contribution from the Charleston Museum, Charleston, South Carolina.

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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN.

New Frogs from Itatiaia Mountain, Brazil

BERTHA LUTZ

ITATIAIA, one of the highest mountains in Brazil (altitude just short of 3,000 m.), is part of the Mantiqueira Range, located on the borders of the states of Rio de Janeiro, Minas Gerais, and São Paulo. The author, who may publish a paper on the anuran fauna of the different life zones later, made two short excursions to this area and, with her local assistants, assembled collections mostly from altitudes between 1,300 and 2,500 m. Three of the frogs collected are new to science and five, although already described, are rare in collections.

Hyla rubra duartei, subsp. nov.

TYPE.—Museu Nacional, Rio de Janeiro, Brazil. A 35-mm. male from Itatiaia Mountain, Brazil; collected by Elio Gouvêa on March 29, 1945, at Macieiras; elevation 1,900 m.

PARATYPES.—Same collector and data, 3 specimens; 9 other specimens from 800 to 2,500 m. E. Gouvêa, Bertha Lutz, and Rita Kloss, collectors.

DIAGNOSIS.—*Hyla rubra duartei* is very similar to *H. rubra rubra* but has narrower and more reduced webs; the dorsolateral stripes, divergent posteriorly, are dilated in front and mostly in contact in the interocular region, forming a club-shaped mark; the light ocelli occupy most of the length of the concealed aspect of the thigh; similar ocelli occur in the inguinal region and often on the inside of the tibia.

REMARKS.—Daudin's *Hyla rubra* is not a simple species, but rather a complex of forms the exact taxonomic status of all of which is not yet entirely clear. Two main patterns occur: in *H. r. rubra*, from the Guianas, there is a pair of longitudinal, uninterrupted, dark, dorsolateral stripes; in Spix' *Hyla x-signata*, from Brazil, the stripes are broken up into an anterior and a posterior pair of inverted parentheses,) (, evidently the basis of the specific name. Most of the specimens and forms collected south of the Amazons River are of the latter type. *Hyla r. fuscomarginata* Lutz is small (26 mm.); the ocellar ornamental pattern on the thigh is entirely absent; the head is very triangular in outline; it is restricted to the coastal plain, with a known range from Santa Catarina to Bahia. *H. r. duartei*, though more distant spatially from *H. r. rubra*, is nearer to it morphologically than to *H. r. fuscomarginata* from the Brazilian lowlands at the same latitude. The new subspecies is named in honor of Dr. Wanderbilt Duarte de Barros, Administrator of the National Park of Itatiaia.

Elosia pulchra, sp. nov.

HOLOTYPE.—Museu Nacional, Rio de Janeiro, Brazil. A 40-mm. specimen from Itatiaia Mountain; collected by Rita Kloss, March 29, 1951, at Brejo da Lapa; elevation 2,200 m.

PARATYPES.—Twelve specimens collected on the same mountain by Bertha Lutz, Rita

Kloss and Elio Gouvêa on different occasions, at altitudes from 1800 to 2,500 m.

DIAGNOSIS.—*Elosia pulchra* differs from other known species in its relatively narrow, fringed digits, with a rudiment of web at the base of the four outer toes, and its striking coloration.

DESCRIPTION.—Very dark, practically purple black above, with old gold, bronze or (more seldom) deep yellow spots, which vary in size and number and which extend to the sides of the head in some specimens. Ventral surface, especially the belly and hind limbs, a deep violet blue, often with a suffusion of pale gold, yellow and pink spots, or an iridescence in tones of mother of pearl covering the gular region and extending slightly backwards. Type 40 mm.; other specimens from 28 to 40 mm., with a mean of 35.

REMARKS.—Other species of *Elosia* show tones of olive, brown and gray above, either with the lower side light and immaculate or, more rarely, with a slight mottling. This is especially true of *E. lateristrigata*, some of which, especially those from relatively high altitudes, are very dark underneath with lighter spots or areas. Except for the presence of vomerine teeth, the large, well developed specimens of *Elosia pulchra* almost suggest the genus *Dendrobates*.

The voice is weak and the lateral sacs were not observed; the song, though slow, is reminiscent of the bird-like trill of the other species of *Elosia*. Most of the specimens were collected in swiftly running or torrential brooks and streams, some of them partly subterranean. A few were caught outside the streams, some sitting in the sun and one running (not hopping) on the bank at some distance from the water. All were taken between 1,800 and 2,500 m. of altitude, considerably higher than the records of the other known species.

Crossodactylus dispar grandis, subsp. nov.

TYPE.—Museu Nacional, Rio de Janeiro, Brazil. A male from Itatiaia Mountain; collected by Bertha Lutz and assistants on March 29, 1951, at Brejo da Lapa; elevation 2,200 m.

PARATYPES.—Eleven specimens with the same collection data. Other specimens taken on other occasions at other elevations.

DIAGNOSIS.—Very similar to *C. d. dispar* Lutz, but much larger (36–42 mm., instead of 26 mm.); body thick set; forearm of the male enormously tumified; a row of black, thorn-like spicules on the outer edge of the upper lip, besides the nuptial spikes found on the first finger of the other species of this genus.

REMARKS.—The voice of the new subspecies also seems different. Whereas the other forms trill, this one was only heard emitting a *Paludicola*-like croak, similar to that which is rarely heard in the others and which serves at best as a prelude to more melodious song (J. Venancio in conversation). The specimens were obtained from 1,300 to 2,500 mm. They are common at Brejo da Lapa and at Maromba, at the latter place at 1,300 m. only.

Crossodactylus dispar Lutz (1925) is cited and figured in a later paper (1930) as *C. fuscigula*, with *C. dispar* and Mueller's *C. bresslaui* as synonyms. *C. fuscigula* seems to be a *nomen nudum*, and *C. bresslaui*, different.

Besides these new forms, some rare frogs were collected, such as *Cyclorhamphus granulosus* Lutz, described from the Bocaina Range on the opposite side of the Parahyba River valley, *Eleutherodactylus* (*Hylaplesia*) *nigriventris* Lutz, *Holoaden luderwaldti* Miranda Ribeiro, *Basanitia gehrti* Miranda Ribeiro, and *Basanitia lactea* Miranda Ribeiro. Two large specimens of *Hyla circumdata* Cope, found at 2,300 meters, lacked the ornamental stripes, and the concealed surfaces, usually lilac, were a deep blackish violet.

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MUSEU NACIONAL, RIO DE JANEIRO, BRAZIL.

On the Systematic Position of the Salamandrid Genus *Taricha* and its Species

GERD VON WAHLERT

IN his paper concerning the species of Californian *Triturus*, Twitty (1942) speculated that *Triturus granulosus* (Skilton) may be the form which stands nearest to the origin of this group and that the other species are more distantly related offshoots. This opinion is based on the idea that the genus *Triturus* embraces the eastern American newts, certain European and Asiatic forms, as well as the Californian group, and on the fact that *Triturus granulosus* agrees more closely than any other Californian species with those outside of California. The characteristics mentioned by Twitty are the egg-laying habits, the size of the eggs, the larval pigmentation, and the range of the species.

During the years 1924–1939, European workers split up this world-wide genus, *Triturus*, into four revived genera (Wolterstorff, 1924; Herre, 1934, 1935, 1939): *Triturus s. str.* in Europe, *Cynops* in southeastern Asia, *Notophthalmus* in the eastern United States, and *Taricha* in western North America. This arrangement has since been partially adopted by certain American herpetologists (H. M. Smith and E. H. Taylor, 1948). Herre (1935), in the most thorough study of salamandrids published in the last twenty years, has put *Taricha* between the lower and the higher salamandrids. The lower salamandrids include *Salamandra* and its closest relatives and *Pleurodeles* and *Tylototriton*. The higher salamandrids are, with others, *Notophthalmus*, *Cynops* and *Triturus*.

The results of my own studies on the anatomy and biology of the reproduction of salamandrids, which have been carried out on 35 of the 43 living species of the family, strongly support these views and reveal some facts which throw a new light on the relationships of the Californian forms ascribed to the genus *Taricha*.

Shape of the Female Cloaca

Salamandra and its nearest relatives have a vent like that of the plethodontids and ambystomids, i.e., without any surrounding walls or elevated surface. The slightly more advanced forms among the lower salamandrids e.g., *Pleurodeles* and *Tylototriton*, show a somewhat protuberant cone on which the vent is situated. The higher salamandrids on the other hand have, as a rule, a strongly protuberant cloaca. Thus, it appears that a general trend exists in salamandrids toward the formation of a protuberant cloaca. The species of *Taricha* have, save for *granulosa*, a slightly protruding cloaca; the shape of the cloaca of *granulosa* is that of a strongly elevated cone. In the genus *Taricha* are found the same developmental stages of the cloaca as in the family as a whole. It may be assumed therefore, that the evolution of the cloaca in the species of *Taricha* has been from a slightly protuberant to a strongly protuberant one.

Method of Egg Deposition

The more primitive salamandrids deposit their eggs in clusters like many of the Ambystomoidea, usually considered as ancestral to the Salamandroidea. The higher salamandrids on the other hand deposit their eggs singly, and the protuberant cloaca serves as ready means of placing them carefully on aquatic vegetation or stones. This function of the cloaca is of special importance to those forms whose simplified epithelium of the oviduct produces a jelly coat for the eggs far thinner than that of other forms. Thus, in *Notophthalmus*, the volume of the complete egg is 9 times greater than the volume of the egg without its jelly coats and 4.5 times greater in *Triturus*, while in *Pleurodeles* the proportion may be 64:1 and in *Taricha torosa* something like 40:1. It may be noted here that the number of jelly layers is four in both *Taricha torosa* (Daniel, 1937) and *Triturus vulgaris*.

In *Taricha* only the form with the strongly protuberant cloaca, *granulosa*, deposits its eggs singly. The egg-masses laid by the other forms, and occasionally by *granulosa*, too, agree with the clusters of *Pleurodeles* in consisting of aggregations of single eggs. The outermost layers of the individual eggs fuse to

form the so-called "common envelope", similar to the common envelope of those species of *Ambystoma* which lay egg-masses (Bishop, 1943: 132). Thus, in the one genus, *Taricha*, are found the same forms of egg-laying as in the different groups of salamandrids: masses comparable to the clusters of the lower salamandrids (the ovoviviparous or viviparous *Salamandra* being an exception) in *Taricha torosa, sierrae, rivularis, klauberi* (if the last named is a species at all), and single eggs as in the higher salamandrids in *Taricha granulosa*. The fact that *Taricha granulosa* deposits single eggs and possesses a strongly protuberant cloaca suggests that a correlation between these two characters exists in salamandrids.

Summary and Conclusions

It may be theorized that the ancestor of the recent species of *Taricha* had a slightly protruding cloaca and laid its eggs in masses. It was more nearly related to the *Pleurodeles-Tylototriton* group of lower salamandrids than to the higher salamandrids which are later offspring. The forms *torosa, klauberi, sierrae, rivularis* are quite close to that ancestral form. *Taricha granulosa* parted from this group by developing a more protruding cloaca and the habit of depositing single eggs, independently from the evolution of the higher salamandrids, among which are *Notophthalmus, Triturus*, and *Cynops*. That the cloaca of *Taricha granulosa* is the result of an independent evolution is evidenced by the fact that its sides are thrown into folds and ribs like the less protruding cloacas of the other species of *Taricha*, of *Pleurodeles* and *Tylototriton*. The cloacas of the higher salamandrids lack these ribs; their surfaces are covered with folds emerging from the vent. The shape of the cloacas of *Taricha granulosa* and *Notophthalmus* may, therefore, be very much alike, but the folds are totally different.

That *Taricha granulosa* is the only species which extended its range far beyond the borders of California, a fact which Twitty considers as supporting his view that it is probably the oldest species, may be regarded as a result of the higher evolution of *granulosa*.

Acknowledgements

I wish to thank Professor R. M. Eakin, University of California at Berkeley, for sending me egg masses of *Taricha torosa* for examination. I also wish to express my gratitude to Professors Myers and Twitty for the privilege of examining a collection composed of the species of *Taricha* which had been sent to Professor Herre. This named collection proved to be very valuable to me since I found that in both the Berlin and British Museum all species of *Taricha* present (*rivularis, granulosa* and *torosa*) are still referred only to *torosa*.

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Figs. 1 and 2. *Agalychnis alcorni*, sp. nov., type specimen. Actual snout-vent length, 48 mm.

A New Hylid of the Genus *Agalychnis* from Southwestern Mexico

EDWARD H. TAYLOR

IN the Mexican collections made in 1949 and 1950 by Mr. J. R. Alcorn for the University of Kansas Museum of Natural History, are two frogs belonging to the genus *Agalychnis* which appear to be undescribed. I take pleasure in naming the species for its discoverer in recognition of the splendid collections of vertebrates he has brought together for the University of Kansas Museum of Natural History.

Agalychnis alcorni, sp. nov.

PLATE I. FIGS. 1 AND 2

TYPE.—UKMNH No. 29763 ♀; south bank Río de Tepalcatepec, 800 feet elevation, 17 miles south of Apatzingan, Michoacán; Nov. 30, 1950; J. R. Alcorn, collector.

PARATYPE.—UKMNH No. 28100, one-half mile east of San Blas, Nayarit; Jan. 6, 1949; J. R. Alcorn, collector.

DIAGNOSIS.—Green above, with a pure white throat and breast; venter, hands, feet, concealed parts of hind limbs, and ventral surface of thigh bright yellow to orange-yellow; nostril nearer eye than to median lip notch; tympanum vertically oval, its greatest diameter slightly greater than three fifths of the eye length; length of eye equal or slightly greater than length of snout; vomerine fasciculi small, transverse, between anterior part of choanae; fingers about one-fourth webbed; inner toes one-fourth or less webbed; outer toes nearly one-half webbed, the digits with fringes reaching to discs; discs only very slightly wider than digits; prominent tarsal fold. Differs from other Mexican species chiefly in having a short, high snout. (Fig. 3, A–D).

DESCRIPTION OF SPECIES.—Width of head (18 mm.) a little greater than length (16.8 mm.); canthus present, rounded, curving forward to the nostril; areas about nostrils swollen slightly without depression between; lateral profile of snout angular at nostrils, the front sloping down to lip rather abruptly, the snout not extending beyond mouth; tympanum vertically oval; a thin fold from back of eye runs above and curves down behind it, in contact with the posterior border; vertical diameter of tympanum (3.3 mm.), contained in length of eye opening (5.1 mm.) 1.55 times; distance between tympanum and eye equal to about half diameter of former; length of eye approximately equal to axial length of snout; loreal region not concave, sloping abruptly to lip; width of an eyelid (4 mm.) about two thirds interorbital interval (6 mm.); tongue free for more than half its length, emarginate posteriorly, wide behind, tapering to half its width anteriorly.

Choanae large, lateral when seen from directly below, the opening partly covered by elevated front edge of choanal wall; vomerine fasciculi small, narrow, transverse, separated from each other by a distance equal to transverse length of a fasciculus, from choanae by nearly once and a half that distance; opening of the palatal glands in two convex grooves, much closer to anterior tip of palate than to choanae; openings of the Eustachian tubes smaller than choanae.

Arms with elbows permanently flexed, the upper arm thin, lacking pigment; forearm much thicker, pigmented above; first finger smaller than second, the discs little wider then digits; fingers about one-fourth webbed with fringes, more or less distinct, extending to discs; subarticular tubercles conical on proximal part of digits, outer ones on the outer fingers larger but not conical, none double or bifid; supernumerary tubercles on palm conical; inner metacarpal tubercle on side of first finger large; large palmar tubercle, tripartite, scarcely distinguishable from the other tubercles on palm; a slight fold or ridge on outer surface of arm extending to elbow; leg short, the heel not quite reaching tympanum; toes with small discs not or but scarcely wider than the digits; two inner toes about one-fourth webbed; between three outer toes nearly one-half webbed; fringes on all digits reaching to discs; an elevated inner metatarsal tubercle; outer small, conical; the outer subarticular tubercles of outer toes large, somewhat moundlike,

others conical; subarticular tubercles small but distinct; a distinct tarsal fold; skin smooth above with a strong skin fold from axilla to groin (this may not be a permanent character); axillary web scarcely evident; a slight inguinal web; chin and breast indistinctly granular, underside of arm indistinctly granular; venter and entire under surface of thigh covered with small distinct granules; posterior face of thigh with the lower part bearing much larger granules; anal flap broad, the vent opening at the level of the middle of thigh.

leg, 62,46; tibia, 21.5,16; foot and tarsus, 31,22.7.

VARIATION.—The paratype, in preservative, has become uniform light purplish above and the ventral and concealed surfaces are flesh-white, the several small spots on the sides are white, seemingly dovetailing with the purplish; the tympanum is slightly larger proportionally, its diameter equalling half the length of eye. The tips of the digits are a trifle larger, distinctly wider than the width of adjoining part of digit.

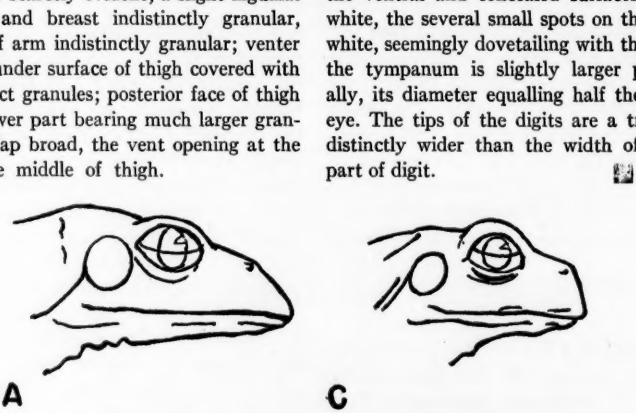

Fig. 3. Mexican forms of *Agalychnis*, somewhat enlarged but drawn to the same scale. A. *Agalychnis dacnicolor*; Tepic, Nayarit. B. *Agalychnis, callidryas;* San Andres Tuxtla, Veracruz. C. *Agalychnis alcorni* (type specimen); 17 mi. S of Apatzingán, Michoacan. D. *Agalychnis moreleti*; Cuautlapan, Veracruz.

COLOR.—In life, green above on head, most of sides, on upper part of forearm and outer finger, on dorsal surface of femur (a narrow stripe) on tibia, tarsus and part of two outer toes; tympanum lavender; iris of eye black; transparent lower eyelid black-edged, with numerous very fine white parallel reticulations; chin and breast paper-white; venter, under surface of thigh and concealed parts of limbs yellow to orange-yellow; a few small white flecks border the lateral green color, and the area about vent is frosted with white; a cream-white line borders the green of the forearm to elbow, and outer edge of tarsus across heel; a few irregularly-placed rounded white dots on back.

MEASUREMENTS IN MM.—(of type and paratype) Snout-to-vent, 48,38; width of head, 18,14; length of head, 16.3,13.6; diameter of tympanum, 3.3,2.5; eye length, 5.1,4.5; length of snout, 5.15,5; arm, 29,23; hand, 12.2,11;

The green color of the type has become somewhat bluish olive-gray, the yellow coloration has become nearly flesh-white.

REMARKS.—This species occurs on the west coast at low elevations in the same general regions in which *Agalychnis dacnicolor* is to be found. The most significant differences in specimens of *dacnicolor* of equal snout to vent length are a very much longer, more attenuated snout; heel reaches middle of eye; vent carried to below level of thigh, the area about opening swollen, protuberant. I include sketches of the head outlines of the three other species of *Agalychnis* known to occur in Mexico. The two forms of the eastern coast may be distinguished by the much larger discs on digits and the flatter, more obliquely sloping snout.

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The Preservation of Natural Colors in Skin Preparations of Certain Amphibia

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In preserved insects, certain reptiles, birds, and mammals the color of the surface of the body does not undergo any change, and thus does not differ in color from living animals. This is due to the fact that while the animals were still alive the pigment was present in the dead substances of the skin, such as the chitinous integument of insects, the horny shields of tortoises, the feathers of birds, and the hair of mammals. As the pigment substances contained in the above products of the skin are isolated from the living organism, the death of an animal cannot in any way affect the state of its pigmentation. On the other hand, the pigment substances found in fishes, and especially those in the amphibians and reptiles, are contained not in the dead skin products but in the cutis itself, that is in the epidermis, corium, and the subcutis. In other words, they are contained in a living organ which, on the death of the animal, undergoes both the physical and chemical process of disintegration, or if the body is preserved, coagulation of the protein substances, dehydration, and so on. Hence the preparations of the said animals, which are placed in fixing liquids, such as formalin, alcohol, or their combinations, first change, and, after a while, lose their natural colors so that, in this respect, they no longer resemble the living animals. As is well known, this is caused by the solution or chemical disintegration of the content of the pigmentary cells under the influence of the fixative in which the animal preparation is preserved.

Animal pigmentary substances react differently to various fixatives. Thus the guanine crystals contained in the guanophores are readily dissolved in formalin, while in alcohol they are not changed. Yellow and red pigments of fatty origin contained in the lipophores become dissolved in alcohol, while in formalin solution they decompose. The specific red pigment contained in the allophores [xanthoerythrophore (Ballowitz, 1913), allophore (Schmidt, 1920)] is not dissolved in alcohol, though it becomes decomposed in formalin. The only pigment which shows great resistance and neither dissolves nor undergoes any chemical decomposition in the above-mentioned fixatives is the black pigment, melanin.

The action of preservatives upon the content of the pigmentary cells results at first in the change, and afterward in the disappearance of natural dyes both of chemical and structural origin in the skin of the preparations of the fishes, amphibia, and the reptiles. In the formalin preservatives the white pigments disappear first, and then the yellow and red, while in the alcohol fixatives white pigments are preserved, though yellow and red dyes and their combinations vanish. In all fixatives, however, the dyes of structural origin, (silver, green, blue, and similar colors) vanish; in each of the preservatives only black or grey colors remain. This accounts for the fact that all the preparations of fishes, amphibia, and reptiles kept in formalin or alcohol preservatives lose the colors which were characteristic of living animals, and, regardless of their previous coloring, acquire a standard type, that is they become in varying degrees grey, brown or black. The animals which, while alive, did not possess any black pigment tend to lose entirely the colors and spots of the skin, while the animals which had black pigment tend to retain only the dark colors and those spots which were produced by black pigment. It is true that other preservatives are used in histology, such as sublimate, acetic acid, and potassium dichromate, and that some of these solutions are able to preserve all the pigment substances and to keep the colors, but only for a short period of time. I do not know of any such preservative which fixes the natural colors of the animals in question for an unlimited period of time.

Since the preparations of fishes, tailless amphibia, snakes and lizards lose their natural colors, they are thus not suitable as material for investigation, either of their natural coloring or the position and the histological structure of the pigment cells. For all fixed chromatophores, except the melanophores, lack the pigmentary substances.

A method which makes possible the safe-keeping of the skins of these animals with their natural colors preserved is demonstrated below.

Method

The technique of preparing the skins of the Amphibia with the object of fixing their natural colors consists of these essential operations carried out in the following order: (1) killing the animal and removing its skin; (2) preparing the skin for drying; (3) drying the skin. Commenting upon them briefly, it should be observed that, first of all, the animal should be killed in such a way as not to cause a change of its natural colors and not to damage its skin. Thus, I suggest the following method of killing the animal: introduce the tips of a pair of scissors into the open mouth and then cut the spine and the spinal cord at the base of the skull. Killing the animal by means of ether or chloroform is not a desirable procedure here since these anesthetics cause a severe haemorrhage of the blood vessels of the skin, making it pink, and thus, changing the natural color.

After the animal is killed, the skin is removed carefully so that it will not be damaged or overstretched. Excessive dryness can be prevented by frequently moistening the skin with water.

Skinning tailed Amphibia (Caudata) such as salamanders or newts is a painstaking process, since the skin of these animals is attached to the muscles along its entire undersurface. On the other hand, skinning the tailless Amphibia (Salientia) is quite easy; owing to the presence of large lymphatic vessels, the skin is not attached to the muscles along its underside. The only species encountered in which the removal of the skin from the cranium presents great difficulty is the burrowing, or spadefoot toad, *Pelobates fuscus* Laur. This is due to the very rough surface of the cranial bones to which the skin is strongly attached. In order to remove the skin, it must first be cut, for which task scissors are used.

There are two ways of making the cut, depending on the type of preparation desired. Thus, if only the dorsal part of the skin is to be preserved, then three cuts are made on the ventral side of the body: one cut along the middle part of the body, from the tip of the lower jaw to the end of the body and two diagonal ones along the legline. If the skin of the entire animal is to be preserved a cut is made along the sides, right or left, of the body, beginning from the angle of the jaws, through the sides of the forelegs, the belly, down to the sides of the hind legs, and, with the tailed amphibians, along the mid-line of the ventral part of the tail. Then another cut is made along the mid-line of the back part of the second hind leg. And, since in the tailless amphibians the latter joins with the cut in the other leg it can be done as one operation. Next, in the tailed amphibians, the skin of both pairs of legs is cut off; however, in the tailless amphibians only the forelegs, which are situated on the opposite side of the body from the side, are cut (Fig. 2). In this way, the entire skin from the back and the belly as well as from one front and one hind leg is obtained.

On removing the skin from a tailed amphibian it must first be separated from the muscles by means of a scalpel. This operation should be started from the middle part of the belly and performed in such a way as to clear first the middle part of the trunk, as this greatly facilitates further skinning. In the tailless amphibians the skin is removed first from the hind legs, then from the belly, and lastly from the head. In those places where the skin is strongly attached to the flesh, such as near the anus, at the walls of the lymphatic vessels, tympanic membranes, eye-lids, nostrils, and the edges of the jaws, it is cut off with scissors.

After the skin is removed, it is rinsed in clear water and placed with its external side against a plate of glass. Then from its internal side (corium) the remaining parts of the muscle, connective and fat tissue, as well as the blood vessels are removed with a scalpel; from any remaining vessels the blood is squeezed. Having thus cleared the skin, it is taken off the glass and, if it contains poison glands (e.g., those of a salamander, or a toad) the contents are squeezed from them because, if allowed to remain, they would make the surface of the dried skin very rough. Afterwards the skin is again rinsed in water and is then ready for drying.

The wet skin is placed on a clear and smooth surface, preferably a mirror glass, its internal side (corium) down. It is important that the skin should be spread symmetrically and very evenly so that it will not make large folds

(small folds will even themselves out in the process of drying), and so that it will touch the glass along its entire surface. Air bubbles which arise between the skin and the surface of the glass should be scrupulously removed by pressing with wet fingers; otherwise, the surface of the dried skin will be covered with blisters. Superfluous water between the glass and the skin, prevents even spreading; it can be conveniently removed by means of blotting paper. The plate, placed in a horizontal position so that the skin will not slide off, is then put in a dry and well-aired place and left there until the skin becomes dry. Proper drying can be most satisfactorily carried out at a temperature of about 20°C. As it dries, the skin will shrink, but only within certain allowed for limits. Since the skin, after its removal from the animal is always somewhat stretched, shrinkage to its approximate size is desirable; care should be taken that its edges do not dry too soon and stick to the glass. Incidentally, this is likely to happen if the drying takes place in an overly heated enclosure or in the heat of the sun.

For completely drying a small and thin skin, roughly one hour is necessary, while for a larger and thicker skin several hours must be reckoned. A well-dried skin gets stuck firmly to the glass, so that after the completion of the process of drying it should be removed by means of a sharp knife with a thin blade. The task can be successfully accomplished in the following way: insert a razor blade between the skin and the glass, lift the freed skin carefully, seeing that no trace of it remains behind. If performed on a smooth glass surface, no difficulties should be encountered. It is suggested that the skin can be best removed, if the start is made at the legs and the tail, proceeding bit by bit towards the center of the skin.

Once the skin is removed from the glass, and after the frayed edges are trimmed with scissors, it is put in an envelope, or stuck by its internal side to a white cardboard by means of a good quality glue. The date on which the preservation of the skin took place, the species of the animal, sex and perhaps some other remarks are written on the envelopes or the cardboard; afterwards they are arranged in the form of a book. Such a book or collection must be kept in a place that is dry (as the dried skin is highly hygroscopic), away from the light (as the light of the sun causes the fading of certain colors in dried skins), and where it will be protected from damage by insects. In this way, numerically large and valuable scientific collections of the color of the skin of amphibians can be assembled, presenting no difficulties either as to the method of storage nor the amount of room taken up in the laboratory.

Results

In applying the above method I obtained (in 1937) the following results with individual species of the Amphibia.

TRITURUS and *SALAMANDRA*.—In the skins of both these amphibians natural colors are well preserved. In *Salamandra* the vivid yellow of the spots on the back is well retained. In the male of the newt (*Triturus*) the blue color of the spots on the back and the caudal fin vanishes. This is a structural color which appears only in the mating season.

RANA TEMPORARIA L. and *RANA TERRESTRIS* Andrz.—In these species all natural colors are well preserved. In particular, the multifarious yellow, yellow-green, bronze-brown, and red colors, appearing in *R. temporaria*, represented by all types of pigmentary cells (Schmidt, 1920) as well as the various shapes of the spots and their position are quite well preserved. The dried skins of this species are among the finest preparations in the collection as far as the preservation of colors is concerned; this is especially important because of the great amount of variation (Fig. 1). The only color value not preserved is the purplish-blue hue of the back (a structural color), appearing in the males of both species during the mating season, especially prominently in *R. terrestris*. Even during the skinning process of such a blue colored male its skin undergoes change, and in the course of drying its blue gradually vanishes. In the completely dried skin there is no trace of such a blue which is replaced here by the usual colors.

RANA ESCULENTA L.—In normally pigmented specimens of the aquatic frog, *Rana esculenta*, the intense green color of the back, produced by the melanophores, guanophores and lipophores, (Schmidt, 1921; Elias, 1932) being a structural color, undergoes change after the skin is dried. In its place a new grey color appears, with a shade of green. On the other hand, the color of the yellow spots cover-

ing the legs, thighs, and the white of the belly are not changed.

Apart from normally pigmented frogs of *R. esculenta*, various pigmentary anomalies occur within that species which are due to the absence of certain chromatophores in the entire skin surface. Thus, there are rare specimens of *R. esculenta* which throughout their life retain bright blue coloring on their backs (Leydig, 1892). These specimens lack lipophores in their skin (Rabl, 1931) and possess only melanophores and guanophores which actually account for this splendid blue, which is a structural color. This blue, like other structural colors, cannot be preserved in dry skin preparations; it changes into ash-grey.

HYLA ARBOREA L.—The bright green color of the back of the small arboreal frog, *H. arborea*, is a structural color produced by melanophores, guanophores and lipophores collected in special pigmentary organs (Bergrün, 1913; Schmidt, 1920), and cannot be preserved in the dried skin preparations. For already in the course of drying the skin, the green color begins to change into ash-grey with a faint green tinge and afterwards remains so. On the other hand, the black contours of the sides of the body and the color of the belly are not changed.

BUFO BUFO L. AND *BUFO VIRIDIS* LAUR.—In the ordinary toad, *B. bufo*, the natural color of the skin of the back and of the belly is well preserved. In the green toad, *Bufo viridis*, the natural colors of the background, produced by the guanophores and the melanophores, as well as the green ends of the skin warts, produced by allophores (Ballowitz, 1930; Goubeaud, 1931) are not changed; on the other hand, the color of the spots of the toad which in the living animal, especially in the females, is beautifully green, loses its intensity and becomes grey and dull.

PELOBATES VUSCUS LAUR.—All the natural colors which appear in the skin of the back and the belly in the living animal of this species are well preserved. Thus, none of the four kinds of pigmentary cells (Juszczyk, 1937) undergoes any changes after drying, either with regard to histological position or chemical structure. Similarly in the flavescent specimens of *Pelobates fuscus* the natural colors produced by guanophores, lipophores, and allophores (Juszczy, 1937) are not changed after the drying of the skin.

BOMBINA VARIEGATA L. AND *B. BOMBINA* L.—In *Bombina variegata*, both the dark color of the back and the yellow spotted color of the belly, produced by the melanophores, guanophores, and the two types of lipophores (Elias, 1936), are well preserved after the drying of the skin. On the other hand, the orange of the ventral spots of *B. bombina* changes soon after the skin has dried into a kind of yellow, a color which is characteristic of *B. variegata*. Thus, since the colors in the spots of both species of *Bombina* have become practically similar, the incidence of warts in the skin of the back of *B. variegata* and their absence in *B. bombina* is the only means of distinguishing the dried skins of these species. The change of the orange color into yellow in the dried skin of the *B. bombina* proves that the lipoidal pigments, which produce an intensive red color, are rather weak and short-lived in comparison with the yellow staining lipoids which are much more durable.

THE FISHES.—The technique of making dried skin preparations of the fishes resembles on the whole that of the Amphibia, though it is somewhat more difficult because the fishes are covered with scales. Generally speaking, the natural colors of fishes, of pigmentary origin, behave in dried fish skins in a similar way to those of the Amphibia. However, the general effect of the preservation of natural colors is destroyed here by certain unfavorable qualities contained in the fish skins themselves. Thus, during the skinning of a fish, some of the scales may fall out, while others may be pushed out of the scale sheaths and, after the drying of the skin, they tend to roll up and stick out from the surface. Moreover, in many species of fishes the whole skin contains a large amount of fat which, when decomposing in the dried skin, changes and destroys the colors under preservation. Only in those fishes which have bare skins like the burbot, *Lota lota*, and those which are covered with small scales, like the tench, *Tinca tinca*, the preparations of dried skins do not differ in external appearance nor in durability from those of the Amphibia. It should, however, be added that the behavior of the colors of structural origin in the dried fish skins is different from that in the skins of amphibians.

REPTILES.—Preservation of natural colors in skins of fresh specimens of snakes which have been dried later on has been described by

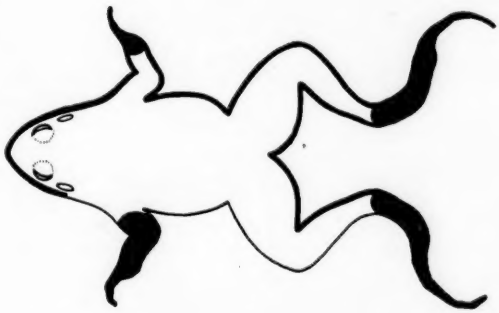

Fig. 1. Dried skin of *Rana temporaria*, female. Prepared in August, 1941, photographed in June, 1951. The dark area of the dorsum and the upper surface of the legs is Burnt Sienna (Ridgway nomenclature); the dark spots behind the tympanum and along the dorsal folds are black; the light ventral surface of the body and legs as well as the light specks in the dorsum are between Cream Buff and Chamois; the bands on the legs and the large irregular spots of the ventral surface vary from Dark Neutral Gray to Dusky Neutral Gray.

Fig. 2. Directions for removing skin. The thick line indicates the cutting line. The black areas show the parts of the body which are to be removed.

Beebe (1947). He also adds that the natural colors, especially the red ones, appearing on the skin of the common coralsnake, *Micrurus mipartitus*, when alive, have been preserved for about 25 years without change. In regard to the skins of lizards and snakes which have been prepared by myself, I have found that the colors of pigmentary origin (for example, those of the European grey and brown viper, *Vipera berus*) have been well preserved, while the structural colors (for instance, green in the European lizard *Lacerta agilis*) disappear.

General Remarks

In conclusion it may be stated, in the way of general observation, that the natural colors of chemical origin preserved by drying the skins of amphibians appear to be somewhat less bright and shiny than in the living animal, though the value of each color is well preserved. This decrease in the brightness of colors is due to the loss of water which in the skin of the living amphibian performs the role of an optically active factor. Thus it is significant that after soaking the dried skin in water, the shade and brightness of color characteristic of the living animal can be restored. In the dried skins of the amphibians in which natural dyes have been preserved, neither the chemical structure nor the position of the chromatophores found in the living skin changes. Therefore, after saturating the skin with water and after proper fixing in histological solutions and staining, the skin of an amphibian is suitable for microtomic slicing and for histological investigation. Just as the structural colors cannot be preserved neither can those colors of chemical origin which are a result of the concentration of the pigment in the chromatophores. This state in the living amphibians is produced by temporary stimuli of a physical character, such as temperature, light, humidity, and also by chemical change produced by hormones or the amount of oxygen in the environment. This is why no color changes, even of chemical origin, produced in the amphibians (e.g., during the mating season) can be preserved by the method given above, since the chromatophores, concentrated by sexual hormones, disperse when death occurs. Finally, since in the skins of the amphibians fixed by drying the design of the skin (the position and the shape of spots) of the living animal is preserved, such preparations can also be used as a suitable material for the study of the geometrical color patterns (Krieg and Forster, 1937) and the role of this type of pigmentation (mimicry) in the life process (Cott, 1940).

Summary and Conclusions

1. The preservation of natural dyes of chemical origin and of the designs of the skin in the Amphibia can be obtained by a special method of drying their skins. The colors thus preserved last for a practically unlimited period of time.

2. In the dried skins only those colors and designs of the skin are preserved which are accounted for by the dispersed state of the chromatophores.

3. The dried skins of amphibians with preserved natural colors of chemical origin and, to a certain degree, also of structural origin may constitute material for both micro- and macroscopical study of pigmentation.

4. The method described does not lend itself to the preservation of natural colors of structural origin (e.g., blue, some greens and their combinations) nor of some bright red colors of lipoidal origin (e.g., in *Bombina bombina*).

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Ichthyological Notes

STATUS OF TWO PERUVIAN SCIAENID FISHES, *SCIAENA STARKSI* AND *SCIAENA WIENERI*.—Hildebrand (1946, Bull. U. S. Nat. Mus., 189: 291-92), after comparing two small examples of *Sciaena starski* Evermann and Radcliffe (490 and 460 mm. in total length) with one large *S. wieneri* Sauvage (1 meter long), was uncertain whether these two species were really distinct, although he kept them separate.

I have recently had the opportunity to examine eight fresh specimens of *S. starski* ranging from 980 to 1,400 mm. in total length. These were caught in a gill net by fishermen at Chinos Bay, Perú (9°22′ S, 78°28′ W), and unfortunately could not be preserved. All agree well with the descriptions of *starksi* by Hildebrand (1946) and by Starks (1906, Proc. U. S. Nat. Mus., 30: 796; where called *S. gilberti*) and differ from Hildebrand's description of his large *S. wieneri*. The only disagreement is in the position of the ventral fins, which corresponds with that given for his large *S. wieneri*.

It is thus demonstrated that *S. starksi* grows to be quite as large as *S. wieneri*, or larger, and that the two species appear to be distinct. Moreover, the only one of the characters used by Hildebrand in his table of differences (p. 292) which does not appear to be valid is that relating to the ventral fin position.—ANTONIO LANDA, *Cía. Guano, Estación de Biología Marina, Chimbote, Perú.*

RECORDS OF FISHES FROM THE GULF OF CAMPECHE, MÉXICO.—The majority of published distributional records on Atlantic coast fishes end at the Río Grande, if the Gulf of México is mentioned at all. The perennial observer from Mars might conclude from written papers that this forms a great barrier and that very few of the common marine fishes of the Atlantic and Gulf coasts of the United States extend into México. It should be pointed out that thousands of pounds of redfish (*Sciaenops ocellata*), black drum (*Pogonias cromis*) and speckled trout (*Cynoscion nebulosus*) are taken annually from the Laguna Madre del San Antonio, which stretches for a hundred miles or so just below the Texas border. Most of them are sold north of the Border. All information at hand indicates that the shallow water area from south of the Border to about the region of Tampico contains more or less the same general types of fishes as the Texas Coast, including large numbers of croakers, family Sciaenidae. Likewise the invertebrate population is much the same and the major portion of the shrimp catch consists of *Penaeus aztecus* Ives, a common species of northern Gulf waters. Somewhere along the coast of México, probably close to Tampico, there occurs a break where the fauna turns tropical, similar to what is found on the west Florida coast somewhere between northern Florida and Fort Myers (see Gunter, Williams, Davis and Smith, 1948, Ecol. Monogr., 18: 309–24).

Recently the writer acquired certain fishes caught by shrimp trawlers in the Gulf of Campeche at a depth of 17 to 20 fathoms. They were taken at a point almost directly north of Carmen and directly west of Mérida, Yucatán. The tropical nature of this area is shown by the species caught, many of which were new to the shrimp fishermen and thus aroused their interest. It is also shown by the nature of the shrimp catch, which consists almost completely of *Penaeus duorarum* Burkenroad. This is the well-known, so-called pink Brazilian, which formed the basis of recent catches in the tropical part of Florida just north of Key West and received considerable publicity in various popular publications.

The shrimp fishermen leave the Texas Coast and go directly across the Gulf, crossing in a period of about 60 hours. After a load is made they return to home port. All fishes mentioned in this paper were placed on ice on the shrimping grounds and were brought to me by Captain Louis S. Miller of Aransas Pass, Texas, to whom I am sincerely indebted for the opportunity to examine these specimens. They were caught during September, 1950.

The collection consists of fifteen species belonging

to eleven families, as follows: Albulidae: *Albula vulpes* (Linnaeus), two, 27.5 cm.; Carangidae: *Seriola zonata* (Mitchill), one, 31.0 cm.; Lutjanidae: *Rhomboplites aurorubens* (Cuvier and Valenciennes), two, 23.5 and 24.5 cm.; Haemulidae: *Bathystoma rimator* (Jordan and Swain), five, 18.5 to 19.5 cm.; *Anisostremus virginicus* (Linnaeus), one, 19.5 cm.; Sparidae: *Calamus leucosteus* Jordan and Gilbert, three, 21 to 26.5 cm.; Sciaenidae: *Eques acuminatus* (Bloch and Schneider), one, 16.5 cm. (This fish was very dark, almost black, and seems to be the dark phase mentioned by Townsend, 1909, 13th Ann. Rept. N. Y. Zool. Soc., p. 28); Kritzler, 1951, Copeia, No. 3, pp. 245–247, refers to *E. a. umbrosus* (Jordan and Eigenmann), a fish corresponding to this description; *Eques lanceolatus* (Linnaeus), one, 13.2 cm.; Labridae: *Lachnolaimus maximus* (Walbaum), one, 23.5 cm.; Scaridae: *Scarus punctulatus* (Cuvier and Valenciennes), two, 16.3 and 18.5 cm.; (Mr. H. H. Hildebrand has informed me that the common scarid on the Campeche shrimping grounds is *Cryptotomus ustus*.); Chaetodontidae: *Chaetodon ocellatus* Bloch, two, 11.5 and 13.5 cm.; *Pomacanthus arcuatus* (Linnaeus), two, 14.0 and 20.0 cm.; *Angelichthys ciliaris* (Linnaeus), two, 13.5 and 21.0 cm.; Cephalacanthidae: *Cephalacanthus volitans* (Linnaeus), one, 11.5 cm.; and Achiridae: *Gymnachirus texae* (Gunter), one, 11.5 cm.—GORDON GUNTER, *Institute of Marine Science, The University of Texas, Port Aransas, Texas.*

RECENT COLLECTIONS OF THE AMBLYOPSID FISH *CHOLOGASTER PAPILLIFERA* IN ILLINOIS.—On August 5, 1950, the writers accompanied by Robert W. Hernquist obtained two series of 13 and 14 specimens each of the spring cave fish, *Chologaster papillifera* Forbes, in Union County, Illinois. The collections were made at two springs about five miles apart along rock bluffs near the Mississippi River, approximately five miles southwest of Alto Pass, Illinois. Material of this species has been taken from two springs in the same region by personnel of the Illinois Natural History Survey, but whether the present localities represent additional stations for this little-known fish cannot be established from the available data.

Both of the springs were of a similar nature. Each consisted of a section of sunken tile from which water overflowed to form a shallow stream which drained into a nearby swamp. The volume of flow was estimated at between one and two gallons per minute, and water temperatures were 12°C and 13°C at 6 PM and 7:10 PM.

The *Chologaster* were captured in depths of three to six inches by hand, by stationary weirs of cheesecloth into which they were driven, and by scooping with a bucket. Their actions were darter-like and they usually sought cover beneath rocks or the overhanging bank. They also seemed to remain near the source of the spring, although the lower reaches of the stream and the swamp were not searched carefully. Philip W. Smith of the Illinois Natural History Survey recently reported (personal communication) that they have dipped *Chologaster* out of the swamp in this area along with pirate-perch, *Aphredoderus sayanus gibbosus* LeSueur, grass pickerel, *Esox vermiculatus* LeSueur, and *Fundulus* (species not mentioned). He suggests that perhaps the swamp itself contains springs.

Gammarus and planarians were very abundant in both springs, and in one, several larvae and adults of the long-tailed salamander, *Eurycea longicauda longicauda* (Green), were also taken. The digestive tracts of three *Chologaster*, 33.6, 29.6 and 22.8 mm. in standard length, contained abundant remains of *Gammarus* in addition to some detritus.

Chologaster papillifera was described by Forbes (1882, Amer. Nat., 16 (1): 1–5) from 8 specimens obtained from a spring at the foot of a bluff in Union County, Illinois. As an addition to the known range of variation of this species the following measurements (means and extremes) for the 27 specimens are given. Standard length, 27.6 mm. (23.0–33.6); greatest depth in standard length, 5.6 (5.0–7.0); head length in standard length, 3.6 (3.3–3.9); head width in head length, 1.6 (1.4–1.7); interorbital width in head length, 3.6 (3.2–4.5); eye in head length, 8.0 (7.0–9.4); principal dorsal rays, 7.5 (7 and 8); principal anal rays, 7.4 (7 and 8). These data agree with those of the original diagnosis and those presented by Forbes and Richardson (1920, Fishes of Illinois: 218–19) with several exceptions. Forbes and Richardson stated that the eye is contained 2.8 times in the head but this is undoubtedly a misprint as reference to the accompanying plate or an actual specimen will show. In the original description the eye in head is given as 6 and the number of developed dorsal and anal rays is said to be 6 and 5, respectively. In our specimens the eye is contained about 8 times in the head length and the number of principal dorsal and anal rays is 7 or 8. This discrepancy is possibly due to a different method employed in measuring and counting. Methods defined by Hubbs and Lagler (1947, Fishes of the Great Lakes Region: 8–15) were used in the present study.

It is assumed that the 27 specimens collected are all subadults, since the vent has migrated only about two thirds the distance from the origin of the anal fin to the confluent branchiostegal membranes. Three specimens, 44.0, 51.5, and 54.2 mm. in standard length, obtained for comparison from the Illinois Natural History Survey, have the vent situated in the ultimate jugular position at the confluence of the branchiostegal membranes. These larger fish also exhibit slightly different proportions

than the subadults. The eye is proportionately smaller in relation to head length, being contained about 10.7 times in the head (rather than about 8.0), and the head is relatively broader, particularly in the interorbital region. In the subadults the interorbital distance goes 3.2 to 4.5 times into the head length, whereas in the adults this measurement is about 2.7.—JAMES N. LAYNE, *Department of Conservation, Cornell University, Ithaca, New York,* and DAVID H. THOMPSON, *Forest Preserve District of Cook County, River Forest, Illinois.*

VARIATION IN NUMBERS OF FISHES SEINED BEFORE AND AFTER A STORM.[1]—Local commercial fishermen believe that their catches are affected by wind direction and force. This is a question that is open to considerable debate. We believe that the following observations in the Rappahannock River, Virginia, justify the belief that winds may have a considerable effect on the movement of fishes.

TABLE I

Field data	Before Storm		After Storm	
Number of 100 foot hauls	4		10	
Time	3:45 p.m.		4:30 p.m.	
Tide	Late ebb		Late ebb	
Water Temperature °C.	32.5		30.9	
Kind of fish	Number of fish	Fish per haul	Number of fish	Fish per haul
American shad, *Alosa sapidissima*	...	...	2	0.2
Alewife, *Pomolobus pseudoharengus*	...	...	19	1.9
Glut herring, *Pomolobus aestivalis*	...	...	2	0.2
American eel, *Anguilla rostrata*	...	...	7	0.7
Spottail shiner, *Notropis hudsonius*	...	...	23	2.3
Satinfin shiner, *Notropis analostanus*	...	...	11	1.1
Small unidentified minnows	...	...	3	0.3
Brown bullhead, *Ameiurus nebulosus*	...	...	1	0.1
Banded killifish, *Fundulus diaphanus*	1	0.25	2	0.2
Hogchoker, *Trinectes maculatus*	1	0.25	3	0.3
Silverside, *Menidia beryllina*	5	1.25	1	0.1
Yellow perch, *Perca flavescens*	...	...	5	0.5
Johnny darter, *Boleosoma nigrum*	2	0.50	...	...
Pumpkinseed, *Lepomis gibbosus*	...	...	1	0.1
Yellowbelly sunfish, *Lepomis auritus*	...	...	1	0.1
White perch, *Morone americana*	3	0.75	180	18.0
Striped bass, *Roccus saxatilis*	1	0.25	23	2.3
Total	13	3.25	284	28.4

Portobago Bay is an expanded section of the southern shore of the river, having an area of about three square miles and an average depth of approximately six feet. While carrying out routine minnow seining in this bay on June 28, 1951, we were forced by a violent squall to suspend our activities. A wind from the west, estimated to reach more than forty-five miles per hour, accompanied by a driving rain, created waves from one and one-half to two feet high that greatly increased the turbidity of the water.

Immediately following the storm we noticed numbers of fish breaking water near shore. Seine hauls made in this locality after the storm caught more species and greater numbers of fish than immediately before the wind arose. About nine times as many fishes per haul were taken after the storm (Table I). It is quite probable that the increased turbidity had some effect on the availability of fish, but our experience in seining waters of varying turbidity leads us to believe that this was not the major reason for the increased catch. It is quite possible also that the change in water temperature was a contributing factor. We believe that the wind-induced wave action and its attendant circulation concentrated the fish on the lee shore. Seine hauls made a short time later on the opposite shore did not take exceptional numbers of fishes.

There is some reason to believe that certain species were more greatly affected than others. The collections of white perch, *Morone americana*, exhibited the most striking difference, for this species was twenty-four times as abundant in the hauls made after the storm.—WILLIAM H. MASSMANN and ERNEST C. LADD, *Virginia Fisheries Laboratory, Gloucester Point, Virginia.*

FISHES ATTRACTED TO SURFACE LIGHT AT NIGHT IN THE GULF OF MEXICO.—During the night of August 27, 1951, the Fish and Wildlife Service M/V OREGON was anchored in about 180 feet of water one and one-half miles SSE of Alacran Reef Light, Lat. 22°33′ N., Long. 89°40′ W., on Campeche Banks. The night was dark and there was a light wind and moderate swell. A 500 watt light with a thirty-six inch reflector hung over the side of the ship just above the water attracted many kinds of fishes which were collected with a small dipnet and meter plankton net.

The fishes collected were: *Harengula humeralis* Cuvier and Valenciennes; *Jenkinsia lamprotaenia* Gosse; *Ahlia egmontis* Jordan; *Strongylura ardeola* Cuvier and Valenciennes; *Strongylura raphidoma* Ranzani: *Hemiramphus brasiliensis* Linnaeus; *Allanetta araea* Jordan and Gilbert; *Dactylopterus volitans* Linnaeus; *Sphoeroides spengleri* Bloch; and *Halieutichthys aculeatus* Mitchill.

There were also abundant larval forms of the following: *Synodus* and *Saurida*, Heterosomata (at least 3 species), *Apogon* and *Apogonichthys*, *Chaetodon*, *Pomacanthus*, *Pomacentrus* and *Abudefduf*, *Prionotus*, *Monacanthus*, *Sphoeroides*, several species of scombroids, serranids, lutjanids, and haemulids.

[1] Contributions from the Virginia Fisheries Laboratory, No. 37.

Invertebrates were several kinds of crustaceans, cephalopods, and polychaetes.

Of especial interest was the appearance at the surface of *Halieutichthys aculeatus*. This species is usually captured in the trawl at depths from 16 to 100 fathoms. A living specimen observed by Longley in an aquarium at Tortugas was found to rest during the day partially buried in the sand. At night it was much more active, creeping about on the bottom or swimming freely and rapidly. The specimen taken by us was on the surface, swimming slowly by using its broad pectoral fins as paddles. The color of the upper surface of the body was rich reddish brown and the pectoral fins were broadly edged with bright yellow. Specimens taken in the trawl are usually dull gray with a network of thin brown lines.

The behavior and appearance of *Dactylopterus* (45 mm. total length) as it approached the light was very similar to that of small flying fish of the genus *Cypselurus*. Its approach was slow and even and the dark blue pectoral fins were completely expanded.

Both *Apogon sp.* and *Apogonichthys* appeared at the light among the swarming larval fishes. Adults usually hide in deep crevices, holes and shells during the day and are presumed to be active only at night. Apparently the young (5 to 10 mm.) at night lead a semi-pelagic existence. I have never seen or taken adult apogonids at a light at night in many localities adjacent to reefs where use of rotenone and dynamite have shown that they were abundant. —Loren P. Woods, *Chicago Natural History Museum, Chicago, Illinois.*

BREEDING HABITS OF *HYPERPROSOPON ARGENTEUM*, A VIVIPAROUS FISH OF CALIFORNIA[1].—Although the live-bearing seaperches and surfperches of the family Embiotocidae are common along most of the west coast of North America and constitute one of the outstanding elements in the local fauna, little has been published regarding their breeding habits. Eigenmann (1894, Bull. U. S. Fish Comm., 12 (1892): 381–478) stated that *Cymatogaster aggregata* becomes gravid about the first of December, after a six-month period of sperm storage. He further stated that the act of copulation had never been observed for any embiotocid. Hubbs (1917, Copeia, 39: 73-74) described the copulation of *Cymatogaster aggregata*, which he observed on July 5, 1916. The female of the mating pair was giving birth to its last young. Two other small species, comprising the genus *Micrometrus* (including *Amphigonopterus*) agree with *Cymatogaster* in the lapse of one year between copulation and gestation (Hubbs, 1921, Biol. Bull., 40: 189-91).

On November 3, 1950, our first definite observations on the breeding habits of *Hyperprosopon argenteum* Gibbons were made underwater with the aid of a self-contained diving apparatus. Mating was taking place in a recess along the rocky shoreline of La Jolla, California. It was then determined that the species was mating in other similar areas along the coast, not only near La Jolla but also about the breakwaters near Newport. Similar activities were noted during diving operations at Pt. Arguello on October 23, 1949, but were not recognized then as involving copulation.

Many individuals were observed in water 4 to 12 feet deep, from 25 to 200 feet offshore, over rocky areas that were interspersed with sand patches. The rather dense bottom plant growth consisted of *Phyllospadix*, *Egregia* and coralline algae.

Ordinarily this species aggregates in more or less dense schools varying in numbers up to several hundred or even thousand. Little tendency to disperse into small groups was noted during the nonbreeding season. While breeding, however, many pairs were found isolated and no large schools were encountered. Schools of 4 to 10 females accompanied by one male were carefully observed. When such a school was frightened, the females would lead off and the male would remain behind as though maintaining a rear guard, warding off intruders, such as other males. At times he allowed the school of females to move completely away. No mating activities were noted in such groups.

Females were much more inquisitive about the diver than the male and frequently came within a few feet of the diver's "blind" behind some seaweed. The courting male, paying no heed to the diver's presence, paraded continuously back and forth in front of the female.

Many paired fish 140 to 170 mm. in total length were observed actively swimming and engaging in breeding activities 2 to 5 feet above the bottom. The male, usually of the same size as the female, remained beside her, unerringly matching her darts and turns. Usually he stayed slightly below the level of her dorsal fin and kept his snout even with her pelvic fins. He frequently passed under the female, brushing her abdomen with his dorsal fin. If the female stopped the male promptly took a position in front of her and swam back and forth, with his snout tilted upward and his fins spread, never more than a body length away.

During actual copulation the genital openings were closely apposed, while the fish were actively swimming as well as when quiet. From time to time the bodies were tilted laterally so as to bring the anal regions still closer together. It is assumed that the spermatozoa are transferred to the oviduct at this stage of mating behavior.

The encroachment of another male was immediately met by a quick charge of the courting male toward the snout of the intruder. Unless the

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 571.

intruder was larger, the courting male was usually not replaced. The males made no attempt to drive away closely related species in the area, such as *Phanerodon furcatus*, *Damalichthys vacca*, *Embiotoca* sp. and *Micrometrus minimus*. A male did not invariably remain with a single female. He often wandered to another, usually unaccompanied female, making his approach conspicuous by tilting his snout upward and then spreading his fins.

In this species the sexes are usually distinguishable in life and the differentiation becomes more trenchant during the breeding season. The anal fin of the male is conspicuously angulated where one ray is modified to form a very strong triangular bony plate. The corresponding ray of the female is little modified. The fins of the male, particularly the pelvics, are lemon yellow and the scales near the pectorals show yellow spots. Series of pigment spots on the body scales form 5 or 6 usually complete vertical bars. The fins of the females are not as pronouncedly colored, but the dark barring of the body is very distinct. During the non-breeding season the bars are faint.

Two males taken from the breeding groups on November 3 were definitely ripe, but a careful examination of a female, by Teh Ping Lin, a fellow graduate student familiar with cytology and chromosome analysis, revealed no ova.

Young taken from a female on January 15, 1951, had a mean standard length of 16.5 mm. Birth of the young began in the ocean about the middle of April, as was also true of some other species of the family (*Brachyistius frenatus*, *Damalichthys vacca* and *Embiotoca* sp.). Specimens born in the aquarium on April 17 to 23, 1951, had a mean standard length of 40 mm. They showed no indication of the natal maturity characteristic of three small species of the family (Hubbs, 1921: 187-89).

The gestation period of *Hyperprosopon* thus appears to approximate 5 to 6 months. In this species the sperm is apparently not stored for any long period. The number of young, commonly 5 to 12, varies with the age of the parent.—Andreas B. Rechnitzer and Conrad Limbaugh, *Scripps Institution of Oceanography, University of California, La Jolla, California.*

DESCRIPTION OF THE YOUNG OF THE KYPHOSID FISH, *HERMOSILLA AZUREA*, FROM CALIFORNIA.—On August 17, 1946, the writer caught two young specimens of *Hermosilla azurea* Jenkins and Evermann, family Kyphosidae, in a tide pool north of the pier of the Scripps Institution of Oceanography, La Jolla, California. They were found schooling with the common opaleye, *Girella nigricans*, a related species. As far as I have been able to determine, young of this size have not been described before. The standard lengths of the specimens were 42.5 mm. and 56.5 mm. Though Barnhart (1936, Marine Fishes of Southern California) did not list this fish in California waters, adults and subadults have been taken by P. Doudoroff in 1938 and by Carl L. Hubbs in 1945 and 1946. The type locality is at Guaymas, Sonora, Mexico, where Jenkins and Evermann first described eight- and nine-inch specimens in 1888. The coloration of the adult differs considerably from that of the young: the adult has about twelve vertical blackish bands along the body, a black opercular blotch, a black blotch in the axil, and the general body color is a dark steel blue, paler below.

A color description of the smaller young is as follows: upper margin of lip black; top of head with three crosswise wavy brown bands, the center one the largest and extending to eye; cheek below eye

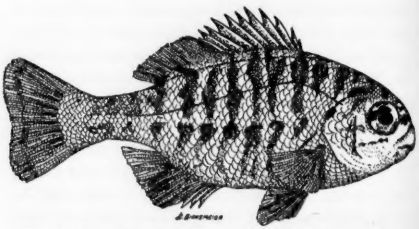

Fig. 1. Young of *Hermosilla azurea*, drawn from a photograph of the live, larger specimen (56.5 mm, standard length).

silvery; a brown band following contour of interopercle; faint black pigment on underside of head and back of lower lip; dark blue spot at upper angle of opercle; a reddish flap below this dark spot; above the spot are a few scales tinged with red; three brown blotches between eye and angle of opercle, the first and second blotches form an almost continuous band; pectoral base has this band continued and looped around base to subopercle; this loop-like band continuous through eye to first band crossing head; from nape to caudal peduncle are seven broad, dark olive-brown bands running vertically to midline, the sixth and seventh joined on caudal peduncle; below midline of body are eight blotch-like bands directed slightly backward; a brown crescent, divided at midline by a narrow silvery area, occurs on caudal base; pelvic spines mainly light, the rays dark olive-brown, with light inner edge; that part of body not covered by the brown bands ventrally is silvery white.

I wish to thank Carl L. Hubbs for allowing me to check his field notes for a comparison of specimens of a larger size. These two young are deposited in the fish collection at the Scripps Institution of Oceanography.—A. S. Lockley, *Biology Department, University of Oregon, Eugene, Oregon.*

FERTILIZATION OF EGGS FROM A CATOSTOMID FISH, *MOXOSTOMA POECILURUM*, KILLED BY ROTENONE.—Successful fertilization was obtained using eggs and sperm from the blacktail redhorse, *Moxostoma poecilurum* Jordan, that had been killed with rotenone.

On the afternoon of April 2, 1951, emulsifiable rotenone (5%) was used to collect a sample of fish from Chewacla Creek, of the Tallapoosa River system, near Chewacla State Park, Lee County, Alabama. The sample included several blacktail redhorse that ranged approximately from 12 to 18 inches in total length. Eggs or milt were lost freely when slight pressure was applied to the sides of the dead fish. While the temperature of the creek water was not recorded, the water must have been approximately 59°F., judging from temperatures in nearby streams.

Fertilization was attempted about five minutes after the fish were collected and were observed to be in spawning condition. Creek water, eggs, and milt were placed in a discarded paper drinking cup. A second attempt at fertilization was made in the laboratory an hour to an hour and a half after the fish were collected. Eggs and milt were stripped from dead fish into a clean laboratory dish, which contained a little tap water. After a minute or so the eggs, water, and milt were transferred into two large flat enamel pans which were then filled with tap water having a temperature of approximately 59°F. The eggs sank rapidly and tended to adhere to the bottom of the pan and to each other. Tap water was allowed to trickle into the pans and into the paper cup, which contained the eggs fertilized in the field. After a few hours, in order to aerate them better, the eggs in the cup were poured into a glass bowl and again placed under the trickle of tap water.

The eggs that had been fertilized in the field were kept separate from those fertilized in the laboratory for a few days until it was evident that both batches were developing well. Within 24 hours after fertilization, white cells at the animal pole could be distinguished clearly from the yellow yolk at the vegetative pole of each embryo. On the third day a random sample of over 500 eggs was examined; not one failed to show development. Hatching was first observed on April 11, and most of the hatching occurred during the next two days. A small percentage of eggs did not hatch, but no count was made to determine the success of hatching, since the success of fertilization after poisoning with rotenone was the point of interest.

There was no evidence that the poisoning of blacktail redhorse with rotenone had any deleterious effect on the eggs and sperm. No effort was made to determine how long after death the eggs and sperm would remain viable. If the use of rotenone for obtaining eggs and sperm from fish is to be of practical or experimental importance, the length of time the dead fish can be held before stripping would be of much significance.—W. A. Garth and J. S. Dendy, *Alabama Agricultural Experiment Station, Auburn, Alabama.*

NOTES ON SOME FISHES FROM CENTRAL PANAMA AND THE CANAL ZONE.—The following notes are based on a collection I made from December 1945 through April 1946, which is deposited at Cornell University. Thanks are due the late Dr. Samuel F. Hildebrand for checking the identifications. Freshwater species were taken at four localities: Barro Colorado Island, C. Z.; Gatun Lake, C. Z.; a small stream between Calzada Larga and Chilibre, R. P., which drained into Madden Lake; and a small, shaded, jungle brooklet near Albrook Field, C. Z., tributary to Panama Bay below Miraflores locks. Marine species were collected at two localities: Farfan beach, C. Z. and Rio Hato, R. P. The sandy beach at Rio Hato, about 120 miles north of the canal, is wide and deep with a shoreline somewhat sheltered by a rocky promontory and a nearby island. There was considerable fishing along this beach by the natives of La Venta, who used dugout canoes and seines 250 feet long by 12 feet deep. These were dropped about 400 feet from shore and then pulled in slowly from the beach. There was apparently little vegetation on the bottom, since only jellyfish, *Murex* snails, and squid were taken along with the fish. All measurements given represent total length in centimeters. The freshwater species are treated first.

Pimelodella chagresi (Steindachner): Three specimens (6 to 7.5 cm.) were caught at Chilibre in a small pool above a riffle. Eight were seen swimming close together and their reaction to the slightest vibration was very noticeable. When caught, they erected their spines, and I was pierced in the thumb, causing a wound that was most painful for well over an hour.

Ancistrus chagresi Eigenmann and Eigenmann: Only one loricariid catfish (6.7 cm.) was caught although more than 15 were seen at Chilibre, many of them larger than the specimen obtained. They were most common where the stream flowed over a large rock outcropping with numerous deep channels. The catfish swam slowly from their attachment on one rock to another, and when I attempted to net them, they darted under boulders or into crevices soon to reappear when the disturbance was over. Their life color was very dark, making them easily visible on the bottom. Hildebrand (personal communication) remarked, "I have on a few occasions even succeeded in lifting stones from the water with the fish attached. I have also caught some by feeling for them under and around stones."

Astyanax ruberrimus Eigenmann: At Albrook Field 7 specimens (4 to 6.5 cm.) and at Chilibre 23 individuals (4 to 5.8 cm.) were collected. This is the most abundant freshwater species in the Canal Zone and its predacious habits are believed to be responsible for the failure of introduced fishes to establish themselves.

Roeboides guatemalensis (Günther): This species was reported by Hildebrand (1938, Field Mus. Nat. Hist., Zool. Ser., 22 (4): 272) as common in Gatun Lake and its tributaries on the Atlantic slope, but is replaced by *R. occidentalis* in the Pacific drainage. In a discussion of the Panama Canal as a passageway for fishes, Hildebrand (1939, Zoologica, 24: 21) stated "no crossing over nor intermingling of the two easily distinguishable species, *guatemalensis* of the Atlantic slope and *occidentalis* of the Pacific, through Culebra Cut, seems to have taken place, as shown by numerous specimens collected in Gatun and Miraflores Lakes." Of the six specimens I collected, one (3.4 cm.) was caught in the Atlantic drainage (at Chilibre) while five (4.6 to 7.2 cm.) were taken near Albrook Field. This may represent the passage of *R. guatemalensis* through Culebra Cut as well as both Pedro Migule and Miraflores locks.

Brachyraphis episcopi (Steindachner): Hildebrand (1938: 299) considered this species to be a high altitude form common in the El Valle region. In a small stream on Barro Colorado Island, well above the level of the lake, 14 males were taken. One male and three females of a very plain color phase were collected at Albrook Field.

Aequidens coeruleopunctatus (Kner and Steindachner): The "Chogorro" is widely distributed in central and eastern Panama. Natives caught them on hooks in Gatun Lake at Frijoles, where the average length was about 10 cm. Two specimens taken by seine along the shore at Frijoles measured 8.5 and 7.2 cm. long. This species was kept as an aquarium pet and readily bred in captivity. The courtship behavior included vibrations of the body with the fins spread, followed by successive interlocking of the jaws as the fish tugged upon one another. About 150 adhesive eggs were deposited on the lower wall of the aquarium where they were constantly fanned by the pectoral fins and guarded by one parent or the other. Upon hatching (4 days after deposition) the young were placed by mouth in a depression made in the sand. These very active yolked young were fanned, guarded and transferred to other sites frequently. Even after the yolk sac was absorbed and the young fish could swim, the parents would engulf individuals that wandered away and spit them back into the school.

Geophagus crassilabris Steindachner: Although Hildebrand (1938: 362) stated that this species is not common in Gatun Lake, I found it to be the main catch of the natives fishing along the shore at Frijoles. The largest specimen seen was 15 cm. long but this cichlid is known to reach a length of at least 26 cm.

Other freshwater species collected include: *Compsura gorgonae* (Evermann and Goldsborough), 1 adult male (2.8 cm.) from Chillibre; *Brycon petrosus* Meek and Hildebrand, the commonest species at Chilibre where 267 specimens (2 to 5 cm.) were taken; *Brachyraphis cascajalensis* (Meek and Hildebrand), 4 females from Albrook Field.

Rhinobatos leucorhynchus Günther: Only two specimens were taken by Meek and Hildebrand (1923, Field Mus. Nat. Hist., Zool. Ser., 15: 68) who recorded it as a "rather rare species." At Rio Hato this species was commonly seined by the natives and discarded. Of the 23 captured, five (35 to 48 cm.) were saved.

Urotrygon asterias (Jordan and Gilbert): Meek and Hildebrand (1923: 83) secured only two specimens of this species. In a single seine haul along the beach at Rio Hato, 14 were taken, of which two (23 and 26 cm.) were saved.

Aetobatus narinari (Euphrasen): This species was not observed by Meek and Hildebrand (1923: 89). At Rio Hato on two occasions it made up the bulk of a seine haul (about 32 specimens).

Mugil curema Cuvier and Valenciennes, and *Bathygobius ramosus ramosus* Ginsburg, were collected at Farfan beach.

The following marine species were collected at Rio Hato: *Mustelus dorsalis* Gill; *Felichthys panamensis* (Gill); *Netuma platypogon* (Günther); *Arius steindachneri* (Gilbert and Starks); *Opisthopterus dowi* (Günther); *Anchoa naso* (Gilbert and Pierson); *Anchovia rastralis* (Gilbert and Pierson); *Cetengraulis mysticetus* (Günther); *Thyrinops pachylepis* (Günther); *Harengula thrissina* (Jordan and Gilbert); *Lycengraulis poeyi* (Kner and Steindachner); *Chaenomugil proboscideus* (Günther); *Sphyraena ensis* Jordan and Gilbert; *Polydactylus approximans* (Lay and Bennett); *Scomberomorus maculatus* (Mitchill); *Vomer declivifrons* Meek and Hildebrand; *Chloroscomberus orqueta* Jordan and Gilbert; *Selene brevoorti* (Gill); *Oligoplites saurus* Block and Schneider; *Sphoeroides annulatus* (Jenyns); *Guentheridia formosa* (Günther); *Prionotus ruscarious* Gilbert and Starks; *Garmannia paradoxa* (Günther); *Paralichthys woolmani* Jordan and Williams; and *Cyclopsetta guerna* (Jordan and Bollman).—HOWARD E. EVANS, *Veterinary College, Cornell University, Ithaca, New York.*

A NEW GENERIC NAME FOR THE SCLEROPAREID FISH *COCOTROPUS DE ZWAANI* FROM THE INDIAN OCEAN.—In 1915, Max Weber and I (*in* Kleiweg de Zwaan, Die Insel Nias bei Sumatra, The Hague, 1915:

275) described *Cocotropus de zwaani* from Nias, in the Indian Ocean just north of the equator and off the west coast of Sumatra. Re-examining the other day the single specimen, I discovered that the gill opening is restricted to a slit above the pectoral. I was also struck by its resemblance to *Prosopodasys leurynnis* Jordan and Seale (1905, Proc. U. S. Nat. Mus., 29: 525) from Hongkong and I therefore asked Leonard P. Schultz to examine the type in the U. S. National Museum. Dr. Schultz kindly answered me that *P. leurynnis* "has the gill membranes joined to the isthmus opposite the middle of the pectoral fin base." It was now clear that neither *C. de zwaani* nor *P. leurynnis* is properly placed in the genera in which they were described and even that they could not be maintained in the family Scorpaenidae. Recently Whitley (1933, Rec. Australian Mus., 19 (1): 102-03) described a new genus and species, *Bathyaploactis curtisensis*, from Australia, in which the gill openings also are restricted and which has the same remarkable long preorbital spines as *C. de zwaani* and *P. leurynnis*. On account of the striking feature of the restricted gill openings, Whitley proposed to place *Bathyaploactis* in a subfamily, the Bathyaploactinae, of the Aploactidae. I think that it deserves family rank and that two more genera can be added, for, as will be clear from the key below, *P. leurynnis* and *C. de zwaani* are not congeneric. A genus name for the former species is available, for Fowler (1938, Proc. U. S. Nat. Mus., 85: 86), apparently without having seen the type, erected the genus *Acanthosphex* for *P. leurynnis*, characterized by the long preorbital spines. For *C. de zwaani* I propose the genus name ***Kleiwegia***, in honor of the collector Kleiweg de Zwaan. The family and the three genera can be diagnosed as follows:

FAMILY BATHYAPLOACTIDAE

Body compressed, without scales. Head without spiny ridges above. At least one of the two preorbital spines very long. Teeth in jaws and on vomer; apparently none on palatines. Gill opening a narrow slit near upper part of opercle. Origin of dorsal on head. Spinous part of dorsal longer than soft part. No pungent anal spines. Pectorals with simple rays only. Ventrals with a spine and two simple rays.

1. Twelve dorsal spines, the three anterior ones separated by a low membrane from those that follow. A. I, 7. Preorbital spines of equal length. Apparently no elongate tubes in lateral line..... ..... *Acanthosphex* Fowler
2. Fourteen dorsal spines, the three anterior ones longer than the others, but not separated by a very low membrane from those that follow. A. I, 8. Preorbital spines of equal length. A series of elongate tubes forming the lateral line..... ..... ***Kleiwegia***, gen. nov.
3. Fourteen dorsal spines, the membranes between the 7 anterior ones deeply notched, those that follow longer than the 7th. A. 11. Lower preorbital spines much shorter than the upper one. A series of elongate tubes and weak spines along the lateral line..... *Bathyaploactis* Whitley

L. F. DE BEAUFORT, *de Hooge Kley, Amersfoort, Netherlands.*

ON INTERPRETING BEHAVIOR IN FISHES.—In a recent article (1951, COPEIA (1): 90-91), Major Chapman Grant deplores the mechanistic point of view in accounting for fish behavior. He prefers to allow some degree of reasoning power to account for observed phenomena. The chief objection to such a viewpoint is that it leads to anthropopathy, rendering the problem more complex and obscuring adequate analyses of behavior patterns. The assumption that fish can reason introduces an indefinite, immeasurable factor which is a needless complication. On the other hand, a mechanistic approach not only allows but demands analysis in the simplest possible terms. As long as these simple terms provide an adequate answer, it is not necessary to postulate reasoning power on the part of the fish, nor even to allow a greater degree of intelligence than is necessary to learn simple stimulus-response reactions.

For an example, let us consider the phenomenon discussed in Major Grant's article, that of trout lying in rows over the troughs of riffles on the bottom of a stream. Major Grant's first explanation of this formation, one which he apparently does not accept himself, is that "Trout like to remain in deep water. Since no deep pools were available in this instance the trout sought the deepest water available, which was in the troughs of the riffles." Statements of this sort are fine examples of anthropopathic thinking, imputing to the fish the same thoughts and emotions as are possessed by man. If, on this basis, we try to find out why trout *like* to remain in deep water, we discover that we are putting ourselves in the place of the trout and are trying to decide, not why the trout like to remain in deep water, but why we would like to be there if we were trout. That is not at all the same thing. The second sentence of this explanation is also difficult to accept, for it implies a high degree of reasoning power and abstract awareness. It implies that the fish is not only aware of that portion of the environment with which it is in direct sensory contact, but is also aware, through memory, of other regions which it cannot see, touch, etc.

Major Grant's second explanation, "The trout are efficient enough to select the place where a minimum of effort will keep them stationary in relation to the bottom," is undoubtedly correct. Except for his implication that the selection is

made by intelligent reasoning, I agree with his statement. However, it is not necessary to suppose that the fish reason in order to account for their lining up in a region of optimum current. The phenomenon is amenable to explanation on the basis of two simple associations (stimulus-response reactions) which are undoubtedly learned very early in life.

One of these associations is that between an appropriate current and the lack of muscular fatigue. Prolonged muscular activity results in fatigue and the inability to continue swimming at the previous rate. Swimming more slowly, the fish drifts. Visual stimuli result in re-orientation in a new location, where the process may be repeated until, by trial and error, the fish finds itself in a "comfortable" current. After relatively few such trials, a fish is probably able to "select" an appropriate current with a minimum of erroneous trials. The association "slow current — no fatigue" thus becomes fixed in the behavior pattern.

The second association involved, that of "obstruction — slow current," may be learned in the same manner. When these two associations have been established, a fish may be expected to swim directly into such a position as Major Grant describes, and to do so without the exercise of any sort of reasoning power.—JAMES E. MORROW, JR., *Bingham Oceanographic Laboratory, Yale University, New Haven, Connecticut.*

OF FISH AND MEN.—It is an interesting observation that while the non-specialists are unlikely to harbor many preconceived notions in such areas of science as physics or mathematics, so many are strongly opinionated concerning the concepts in other scientific fields, as for example, animal psychology. A case in point is a recent note "Behaviorism in Fishes" by Major Chapman Grant (1951, COPEIA, (1): 90). Mr. Grant deplores the "growing school of thought" that would leave "... out any trace of psychological reason" in their exploration of fish behavior. He is particularly critical of Dr. James Morrow and Mr. James Atz in their efforts to explain schooling behavior on the basis of known physical and biological capacities of the species. According to Mr. Grant, "... fishes live in a world that is physically identical to ours and that psychologically they differ from us in degree only."

That fishes live in a world physically different from ours is self evident. That their mental capacities also differ is a problem which seriously concerned students of animal psychology a half century ago. It is apparent that Mr. Grant is unaware or unappreciative of the progress that has been made in the science of animal behavior during these years. Starting with Jacques Loeb and C. Lloyd Morgan—who in their struggle against anthropomorphisms and the use of anecdotal evidence demanded that the same critical scientific attitude should be applied to problems in animal behavior as are customarily applied to problems in biology, physics and chemistry—we find a large array of sound scientific studies which indicate pronounced qualitative differences in the minds of lower vertebrates (and invertebrates) as compared with those of man. Almost independently the neurologists, under the leadership of C. J. Herrick, reached a similar conclusion based primarily on the striking organizational differences in the brains of fishes and humans. These discussions are not all couched in scientific jargon or hidden in obscure publications. One needs only to turn to the article "Psychology, Comparative" in recent editions of the *Encyclopaedia Britannica* (from 1948) for an excellent popular review of the subject. In view of these studies, the unsupported assumptions of Mr. Grant, and especially his confident use of terms such as "purely mechanical" and "volition," represent an antiquated and sterile approach which tends to conceal the real problems in animal behavior.—LESTER R. ARONSON, *Department of Animal Behavior, The American Museum of Natural History, New York, N. Y.*

Herpetological Notes

A NEW RECORD OF A LITTLE-KNOWN SNAKE, *OPISTHOTROPIS ANDERSONI* (BOULENGER), FROM HONG KONG.—The discovery of a further specimen of *O. andersoni* seems worthy of record since it appears that only six others are known. The type, a male, is in the British Museum (Natural History), having been received there in 1888 from the Director, City Hall Museum, Hong Kong, to whom it was originally presented by Mr. C. Ford; the locality given is Hong Kong, but the habitat is not known. Five more specimens were collected by Wall who described them in 1903. They were all captured in a swamp near the Sanatorium on the Peak (Hong

Kong Island), and it has been said that this Sanatorium stood at an altitude just under 1,000 feet; one of them was dug up at a depth of about two feet below the surface. These five specimens of Wall's are not in the British Museum (Natural History) and it is unfortunate that there appears to be no indication as to what became of them.

The renewal of acquaintance with this snake, after a lapse of nearly 50 years, occurred when a female was captured by the writer on June 11, 1950 in the Peak district of Hong Kong Island. It was found after dark with the aid of a flashlight, and when first seen was moving about slowly beneath the surface in very shallow water in a small rocky stream at an altitude of approximately 1,000 feet.

This snake (Fig. 1) has the following characteristics: supralabials 8 (left) and 9 (right), the fifth

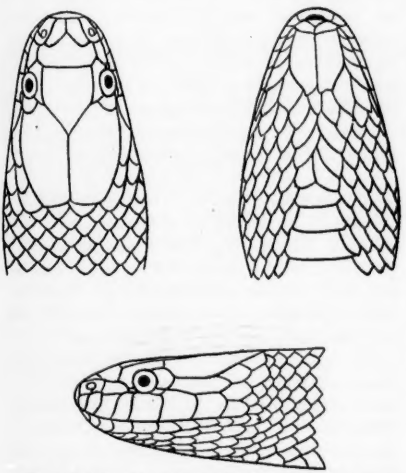

Fig. 1. *Opisthotropis andersoni* (Boulenger). Dorsal, ventral and lateral views of the head.

in contact with the eye; infralabials 9; supraocular extending well down in front of eye; preocular 1, very small; postoculars 2; temporals 1 + 2; scales in 21 rows on the neck (counting from first ventral), reducing abruptly to 17 rows throughout, feebly keeled; ventrals 157; anal divided; subcaudals 53, all paired; color (in spirit) uniformly greyish black above and yellow below, the two colors meeting on the ultimate row of scales; total length 360 mm., tail 66 mm. The specimen is now in the writer's private collection.

Whether it is a rare snake or merely seldom encountered by reason of aquatic (or semi-aquatic) and possibly nocturnal habits, only further collecting can determine. References to the literature, including Boulenger's and Wall's descriptions, together with a figure of the head of the type, have been given by Pope (1935, The Reptiles of China: 166–167).

The writer is grateful to Mr. Tang Ying Wei for the accompanying drawings of the head of this specimen.—J. D. Romer, *c/o Urban Council, Hong Kong.*

EXTENSION OF RANGE AND HABITAT OF THE ECUADORIAN CASQUE-HEADED FROG, *TETRAPRION JORDANI.—Tetraprion jordani* Stejneger and Test has been previously recorded only from the area of Guayaquil, Ecuador, the type specimen coming from Guayaquil. A second specimen (Stanford Univ. No. 2272) was collected by G. S. Myers in Milagro, Province of Guayas, on February 19, 1938; and a third (SU 6407) by D. L. Frizzell on Puna Island, January, 1941 (Myers, 1942, Proc. Biol. Soc. Washington 55: 152–155). These localities all fall within a fifty-mile radius of each other and all lie within the lowland savanna zone of Ecuador at near sea level elevations, although there are scattered remnants of dense rain forest left near Milagro.

Therefore, the collection of a fourth specimen (SU 10605) by the author is of interest not only because it extends the range of this frog 136 miles to the north, but also because it places it in the wet tropical zone of western Ecuador at an elevation of approximately 2,000 feet. This specimen was collected on the warm, clear night of September 2, 1950, in the Andean foothills near Hacienda Lelia (ca. 36 linear miles west of Quito on the road which connects that city with Santo Domingo de los Colorados, Province of Pichincha). It was about four feet above the ground clinging to the trunk of a large banana tree. The latter was at the edge of a banana grove that bordered a small stream on the opposite side of which was virgin jungle.

When collected, this frog was a very light green all over. In a khaki-colored collecting bag it became deep chocolate, and later proved able to turn a variety of colors, including a very light cream when placed on white paper. Its most common color, however, was a slightly orange-buff. The casque was readily apparent while the animal was alive and changed color in consistency with the rest of the body.

The connection of the peculiar frog with Stanford University and Stanford collectors, mentioned by Myers, still continues.—John W. Funkhouser, *Natural History Museum, Stanford University, California.*

THE WARTY GECKO, *HEMIDACTYLUS TURCICUS TURCICUS* (LINNAEUS), IN NEW ORLEANS, LOUISIANA.—The warty gecko has been introduced by human agencies into the Antilles and Gulf coastal México, but has been recorded

in the United States only from Key West and near Miami, Florida. In August, 1949, 14 warty geckos were collected by Mr. E. N. Lambremont in the Gentilly residential district of New Orleans. Mr. Lambremont reported seeing many other individuals at that time, darting about on the screens of lighted windows, and local residents assured him that the geckos had been there for some years.

On March 14, 1950, the author discovered another colony of geckos in an old patio near Bourbon and Toulouse in the New Orleans French Quarter. Its proximity to the dock area, eight blocks, suggests introduction by incoming ships. The patio is in a state of considerable disrepair, and many large pieces of fallen or loose plaster furnish ideal hiding places. Geckos were frequently seen at night, running about high on the walls of surrounding buildings, and were easily collected behind loose plaster or bricks during the day. A total of 27 geckos were collected over a period of 14 months. The final collections, made in March, April, and May, 1951, are considered particularly significant, for on February 1, 2, and 3, New Orleans experienced the most severe cold weather in over 30 years, with below freezing temperatures for 52 hours, and a minimum of 20° F. Although all tropical plants (bananas, monsteras, etc.) in the patio were killed, the geckos survived.

Snout-vent lengths in the geckos ranged from 22.3 to 53.0 mm., with an average of 32.2; sexually mature individuals of both sexes were present. All specimens have been deposited in the Tulane University verterbrate collections.—Richard E. Etheridge, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

THE PYGMY RATTLESNAKE, *SISTRURUS MILIARIUS BARBOURI*, IN SOUTHWESTERN FLORIDA.—Recently Catlin reported a supposed range extension for Barbour's pygmy rattlesnake in Florida (1950, Copeia (1): 59–60). He stated, "According to Gloyd (1940, Chicago Acad. Sci. Spec. Publ. 4) *Sistrurus miliarius barbouri* Gloyd has never been reported from the extreme southwestern portion of the Florida peninsula (including) all of Monroe and Collier counties, and a good part of western Dade County . . . (It) seems to live mainly in dry country (and thus) the population of these snakes in this (Collier County) locality is probably small." On all these points Catlin was in error.

Gloyd did not make the statement attributed to him; he gave (p. 62) the range of Barbour's pygmy rattler as "throughout Florida." Carr listed both Dade and Monroe County records for the form, and observed that it is state-wide in distribution (1940, Univ. Fla. Publ., Biol. Sci. Ser. (3): 95).

Local workers well know that the pygmy rattler occurs over all South Florida except the Keys. Almost anyone who has collected for long on the Tamiami Trail has taken this snake, which is abundant in the area where Catlin believes it rare. I have found it at many localities on the Trail in Collier County, on the Cape Sable road in western Dade County, and near Shark River Fishing Camp in Monroe County.

Carr, who collected extensively in Florida, gave the habitat of Barbour's pygmy rattler as "All types of flatwoods; nearly any kind of terrain where lakes and marshes are frequent . . . Usually found near water" (*idem*). I have often collected these snakes about the borders of cypress ponds in flatwoods.

The aspect of Collier County, where Catlin found the species, is almost entirely one of flatwoods and cypress ponds. Accordingly, one would expect the form to be unusually abundant there. Such indeed is the case. Each year the Reptile Institute receives hundreds of pygmy rattlers, and the region between Immokalee and Ochopee, in Collier County, has yielded a very large percentage of this material. —Wilfred T. Neill, *Research Division, Ross Allen's Reptile Institute, Silver Springs, Florida.*

OCCURRENCE OF THE SPADEFOOT TOAD, *SCAPHIOPHUS HOLBROOKI HOLBROOKI* (HARLAN), NEAR ALBANY, NEW YORK.—Available locality records of the spadefoot toad show that it occurs northward to extreme southern New York and to central Massachusetts. In April, 1940, during a wet spring, calling and mating spadefoot toads were observed in an abandoned cellar hole on Kenwood Avenue, Elsmere, about 4 miles southwest of Albany. In September, 1942, the writer uncovered a single specimen in his yard, about 2 feet down in the dune sand that covers much of the Albany plain. On the evening of April 9, 1951, spadefoot toads were again observed calling and swimming in two rainwater pools along Elm and Murray Avenues, respectively, about 2 miles southwest of the first sites. The next day, in the Murray Avenue pool, 8 pairs of the toads were seen along with many egg masses. These records represent a northward range extension of at least 100 miles. Specimens have been deposited in the New York State Museum, Albany, and Cornell University, Ithaca, New York.—Ralph H. Smith, *2-A Ridge Road, Delmar, New York.*

AN ADDITIONAL RECORD FOR THE PURPLE SALAMANDER, *GYRINOPHILUS P. PORPHYRITICUS*, FROM MAINE.—The purple salamander occurs from Maine westward to Ontario, Canada, opposite Buffalo, southward through the mountains of the eastern states to Virginia, Tennessee, and possibly Alabama (Bishop,

1943, Handbook of Salamanders: 367). More recently, Hall (1947, COPEIA (1): 68) has recorded the purple salamander from Iron Hill, about 80 miles southeast of Montreal, Quebec.

Previous records for this species from Maine, as cited by Dunn (1926, Salamanders of the Family Plethodontidae: 265–266), include the following localities: Cumberland Co., Brunswick and North Gorham; Kennebec Co., Manchester; and Oxford Co., Norway. These localities are in the southwestern part of the state. There are apparently no other published records for Maine.

On June 20, 1951, a specimen of *G. p. porphyriticus* was secured from a small brook tributary to Pleasant Pond Stream about 2 miles northeast of Caratunk, Somerset County, Maine. This specimen, a female, measured 130 mm. It was collected under a large rock in shallow water. Two other specimens were observed beneath rocks but were not caught. Specimens of *Eurycea b. bislineata* were also collected from this brook. In the immediate vicinity a gravid *Storeria o. occipitomaculata* was found under a board in a small grassy clearing, and three *Diadophis punctatus edwardsi* were taken from a shale bank along an adjacent road-cut.

This record for *G. p. porphyriticus* constitutes a northward range extension in Maine of approximately 60 miles and is a new county record.—J. A. FOWLER and ROBERT SUTCLIFFE, *Academy of Natural Sciences, Philadelphia, Pennsylvania.*

REVIEWS AND COMMENTS

ECOLOGICAL ANIMAL GEOGRAPHY. By W. C. Allee and K. P. Schmidt. Second edition, based on *Tiergeographie auf oekologischer Grundlage*, by Richard Hesse. John Wiley and Sons, Inc., New York, 1951: xiii + 715, 142 figs. $9.50.—Fourteen years have elapsed since the publication of the first edition of this well-received work. During this interval, rapid strides have been made in ecology, zoogeography, and systematics—which produces much of the raw material basic to the biological sciences. This new edition brings the advances of the past decade more nearly in line with current knowledge. It is marked by much expanded chapter bibliographies, considerable rewording and simplification of the text, and pertinent augmentation of subject matter. The contribution is essentially a new presentation rather than a simple translation of the German text, although many of Hesse's pioneering data are interwoven with the new material.

The book is divided into four major divisions: Part I, which contains the meat of the book, presents a broad picture of the mutual influence of environment and animal life upon each other. Parts II to IV cover, respectively, the environments in the oceans, in the inland waters, and in terrestrial regions, and their associated faunas. Man's effect on the distribution of other animals is treated in the concluding chapter, and the opening chapter gives a clear outline of the content of zoogeography. The major revision has been in these two chapters. The problem of how and why animals live where they do is a central theme of the book.

In format the second edition is much more pleasing than its predecessor and the augmented bibliography is far more useable, not only because it has been expanded to include the pertinent recent literature but also because full titles have been added and each chapter bibliography is alphabetically arranged. More than 1400 references are cited, of which a major proportion comprise foreign titles. Nearly 3000 items appear in the very useful 41 page index that closes the book.

Conspicuous by its absence in this book, as well as in the *Principles of Animal Ecology* (in part by the same authors), is the fundamental concept of the *ecological niche*, as advanced by the late naturalist Joseph Grinnell. The term *niche* is used by Allee and Schmidt synonymously with biotope for an "area showing uniformity in the principal habitat conditions." Grinnell's concept is strikingly different, for it involves "separate cubby-holes or dwelling places or habitats (in the narrowest sense), which differ in essential respects from one another." The ecological niche of a given species is the sum total of all such separate cubby-holes occupied by that species during its existence and hence has no immediate boundaries in space or time. This dynamic concept is used today by botanists and zoologists and is, in the reviewer's opinion, much more desirable than Hesse's "facies," a roughly similar term currently used in geology and paleontology in quite a different sense. Reflecting the American school of thought, at least, the authors present (Chapter 7) convincing data and argu-

ments to support the theory of the general permanence of the major continental masses.

Allee and Schmidt have produced a most readable book crammed with interesting information. It should be on the desk of every student and professional worker interested in the how and why of animal distribution. Unfortunately its high price will keep it beyond the personal reach of many deserving students and others.—ROBERT RUSH MILLER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

THE CLASSIFICATION OF ANIMALS. By W. T. Calman. Methuen's Monographs on Biological Subjects. John Wiley and Sons, N. Y., 1949, vii + 54 pp. $1.25.—This little booklet, by the former Keeper of Zoology in the British Museum, presents an introduction to the aims and methods of systematics at the level of the undergraduate student. It covers the basic aspects of classification and nomenclature that should be common knowledge to the general student of zoology and closes with a list of the important bibliographies, abstracting journals, general books of importance to systematists, and an index. The booklet is worth perusal by advanced as well as beginning workers, since it includes some words of wisdom on systematic categories.—ROBERT RUSH MILLER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

THE EMIGRATION OF ANIMALS FROM THE SEA. By A. S. Pearse. Sherwood Press, Dryden, New York, 1950: xii + 210, 24 figs. $5.00.—Those who are familiar with Professor Pearse's book, *The Migrations of Animals from Sea to Land*, will welcome this somewhat expanded, revised edition which makes more readily available the author's interesting story of life's origin and the gradual and complicated emigration of animals from the sea to the land. In large part, this is an ecological study, and few are better qualified to tell the story than A. S. Pearse. His first-hand experience with littoral habitats and their varied animal groups over the world has produced a wealth of information which is herein summarized. Routes from the sea, the various causes of emigrations to the land, and how the animals have changed are outlined in three successive chapters. Pearse favors the sea-beach route as the most plausible emigration path from sea to land and claims that few animals have invaded fresh water, and thence the land, by moving through estuaries. Some of the documentation for general statements seems unnecessary and detracts from the readability, and the price of the book seems unduly high. There is a valuable bibliography of 900 entries which is followed by a useful index.—ROBERT RUSH MILLER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

ZWISCHEN ATLANTIK UND PAZIFIK ZOOLOGISCHE REISEKIZZEN AUS NORDAMERIKA. By Robert Mertens. Alfred Kernen, Stuttgart, 1951. 160 pp., 60 photographs. DM 9.50. [about $2.30].—When a post-war exchange fellowship brought him to this country, Dr. Robert Mertens and the United States were both fortunate. It was my own good fortune to be named his official sponsor, and this made the Chicago Natural History Museum his principal base. Here he engaged in herpetological studies, and from this base he visited the Pacific Coast, Florida, and the Blue Ridge. After attending the 1949 meetings of the American Society of Ichthyologists and Herpetologists in Washington, D. C., he visited the museums in New York and Cambridge, and after three months crowded with herpetological studies and experiences, he set sail to return to his duties as director of the Senckenberg Natur-Museum in Frankfurt am Main. Dr. Mertens is one of the senior herpetologists of Germany, and his American journeyings gave him the continued delight of seeing in the flesh a multitude of creatures long known to him by name, and often enough, of seeing in the wild frogs and snakes long known to him in his own wonderful terraria.

His record of this American visit reflects an intensity of enthusiasm for the American fauna thus encountered that will long be difficult to match. He was, indeed, an enthusiast for the American scene from his first glimpse of New York City to his last, and his interests by no means neglected our vegetation, our birds and mammals, or our insects and invertebrates. But in his book it is to the amphibians and reptiles that his interest returns, and along with them to the students of these creatures who made him welcome everywhere. They found their own interests strengthened by the enthusiasm of this distinguished foreign savant, to whom the capture of a plains gartersnake in a suburban backyard near Chicago was an event to be recorded together with his trips to the Californian deserts, to the Florida swamps, or the New Jersey pine barrens. He put us all in his book, so that it reads like the list of members of our herpetological society brought to life in an aura of herpetological interest. He put every one of the American amphibians and reptiles that he saw or captured into the book too, so that it is a segment of the North American Check List also made to come to life in the light of his enthusiasm.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

THE REPTILES OF OHIO. Second Edition (with revisionary addenda). By Roger Conant. Univ. of Notre Dame Press, Notre Dame, Indiana. [4] 284, 38 pls. 1951. $3.50 [bound].—The appearance of Roger Conant's *Reptiles of Ohio* in 1938

was a landmark in the development of herpetology in the Eastern United States. It adopted the spot-mapping technique, brought state distribution into relation with physiographic areas and with the geographic range of the species, and assembled life-history data into a readable synthesis. When it appeared in 1938 it was hailed by the reviewer in COPEIA (Mrs. Helen T. Gaige) as a work doubly useful in being directed to both the technical herpetologist or zoologist and to the general public interested in natural history. It has been a matter of concern that this useful work should be out of print.

Complete revision of the text for a new edition proved to be impossible for financial reasons. Much as we should have liked a completely rewritten work, in which the accumulated notes of thirteen years could be integrated into a harmonious whole, we may well content ourselves with the compromise solution of adding 84 pages of "revisionary addenda" including a completely new set of maps. The mapped records of the brown-backed skink are now four instead of one, and in many cases the increase in records is of the order of 50 to 100 percent. Thus the republished first part of the *Reptiles of Ohio* retains its usefulness to the general public and specifically for school use; and the technical addenda are available for ready reference by the herpetologist.

The important revisions of *Storeria* and *Opheodrys* and of certain species of *Natrix* and *Thamnophis* and *Elaphe* have been included.

One of the most interesting additions to the zoology of Ohio, the discovery of natural populations of the prairie gartersnake, *Thamnophis radix* in the north central part of the state is brought into relation with the hypothesis of postglacial dispersal via the "Prairie Peninsula." It is tempting to speculate that the dispersal of *Thamnophis bulleri* and *T. brachystoma* may represent *interglacial* dispersals of the same nature, and that their ranges are relicts, not of the last prairie peninsula but of an earlier one.

The subject of the changing of the names of the common gartersnake and ribbonsnake, which Klauber has shown to be required on both zoological and nomenclatural grounds, is discussed. Both Mr. Conant and the reviewer have taken the stand that the rules were made for zoology and for zoologists, not *vice versa*, and that this specific case is one of those in which change is to be deplored (Schmidt and Conant, 1950, COPEIA, 1: 58).—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

OPREDELITEL PRESMYKAIUSCHIKHSIA I ZEMNOVODNYKH. (ENCYCLOPEDIA OF REPTILES AND AMPHIBIA.) By P. V. Terentjev and S. A. Chernov. Third Edition. State Publishing House of Soviet Science. Moscow, U. S. S. R. 1-340, 123 fig., 37 maps, boards, 1949. $1.50.—The herpetology of the Soviet Union is rich and varied, but literature available to Westerners regarding this vast region is sparse. Since A. M. Nikolsky's important monographs, published 1915–1918, nothing comparing to the present work has been published. This handbook, "Issued by the Ministry of Higher Education as a Study Manual for Faculties of Biological Departments in State Universities," seems to possess all the attributes of a good review.

In general the book contains the classification and distribution of amphibians and reptiles of Russia. In addition to diagnostic keys and brief descriptions of each species, there are notes on the life history of each species. The 158 indigenous species of amphibians and reptiles, none of which have been designated subspecifically, can be numerically and generically broken down as follows: Caudata, 6; Salientia, 6; Testudinata, 6; Squamata (Lacertilia, 18 + Ophidia, 20), 48.

The introduction discusses general herpetology (with a reference to Ridgeway's "Color Standards"), preservation of specimens, care of amphibians and reptiles in captivity, and poisonous species and treatment of venomous bites. A discussion of each species comprises the major portion of the book. The bibliography is extensive, mostly Russian in nature, but references of the Western Hemisphere, such as Taylor's Scincoid monograph, and Mertens and Muller's 1940 check list of European species, are faithfully acknowledged.

The book is illustrated with excellent pen-and-ink illustrations of Russian amphibians and reptiles; good diagrams of diagnostic characters of closely related forms are also given. The maps are simply outlines of the U. S. S. R., with the range of each species shown by heavily-drawn lines, many of which overlap one another, and thus make them rather difficult to interpret. The text is printed on good resistant paper, a definite improvement on many other Russian zoological books that are printed on poor, newsprint-like paper. Unfortunately, very few American herpetologists will be able to make full use of this manual; it is printed wholly in Russian, except for scientific names.—ROMEO MANSUETI, *Maryland Department of Research and Education, Solomons, Maryland.*

GLI ANIMALI SULLE TERRE E NEGLI OCEANI: LA DISTRIBUZIONE GEOGRAFICA DELLE ATTUALI FAUNE CONTINENTALI, INSULARI E MARINE. By Giuseppe Cei. Firenze, Italy. La Nuova Italia Editrice: 1-626, illus., Boards, 1946. $3.00.—Few books on zoogeography have been published in Italy; this one should be welcomed as an important contribution for naturalists everywhere. Except for some general works, nothing as comprehensive as this text, deal-

ing with the animals of land and ocean with special reference to the geographical distribution of faunal elements on continents, islands, and the sea, has appeared since World War II. This book represents Volume II of the series entitled "Scienza E Natura."

In the introduction, Professor Cei, a distinguished Italian zoologist known for his herpetological contributions in recent years, discusses the geological background of animal distribution. He devotes a large part of this essay to expounding and illustrating the theory of continental drift from the Cambrian, Jurassic, and Pliocene, based on a wealth of references. The historically-important works of Sclater and Wallace are fully reviewed; however, Cei adopts the scheme of classification proposed by Lydekker in 1896 in which the major realms and their political land masses are as follows: Artogeico (Africa, Asia, Europe, and North America); Notogeico (Australia, New Zealand, and Oceana); and Neogeico (South America).

With a wealth of detail, Cei presents the characteristics and relationships of the fauna of each of the regions and sub-regions of the zoogeographical realms. He treats the animal life of each division phylogenetically, that is, from invertebrates through mammals, and presents a prodigious number of examples, many of which have been gleaned from more recent references than Wallace's standard work. The discussion of the Nearctic region, for example, is based on the works of Pratt, Jordan, Evermann, Anthony, Hamilton, Cory, Ridgway, Stejneger, Ditmars, Dunn, Conant, Pope, Bishop, Wright, etc. Most of his standard references do not go beyond 1943. Cei's faithful consultation of such numerous and important papers is reflected in the value of his work.

The fauna of oceans and seas are briefly considered, and the divisions of marine zoogeography are based on the broad oceans between the continents. A chapter is devoted to the ecological and vertical stratification of fauna in the various marine realms. In addition, one chapter discusses the present status of the existing fauna on various land masses and measures taken for their protection.

The book is lavishly illustrated with excellent photographs and poor line drawings. The latter, found on every page throughout the text, delineate, with a minimum detail, the characteristic animals. To a degree these figures enhance the artistic aspects of the book, but that is all. The large number of maps, many to illustrate the distribution of fossil and recent animals, are valuable additions to the text. Frequent references to the abundant polyglot literature of Eurasia and North and South America is Cei's most creditable virtue, and his book, probably prepared under numerous difficulties, should prove to be useful to students of animal distribution.—ROMEO MANSUETI, *Maryland Department of Research and Education, Solomons, Maryland.*

VITA ANFIBIA: I ROSPI E LE LIBELLULE. By J. Rostand and G. Colosi. Firenze, Italy. La Nuova Italia Editrice: 1-280, illus., boards, 1946. $2.50.—Italian publishers have recently shown an interest in good zoological texts since the War's end, contrary to their usual antipathy to scientific writing which, they say, does not sell well. This volume, devoted to the natural history of toads and dragonflies, is Volume I of a series devoted to "Scienza E Natura."

This book was originally embodied in Rostand's well-known French works, "La vie des Crapauds" and "La vie des Libellules." Professor Colosi, an enthusiastic Italian zoologist, is more or less an editor to Rostand's original researches. The former's contribution to the book is the introduction devoted to fresh water fauna and characteristics of amphibious animals, associated with the life histories of anurans.

Rostand's life history of the European toads is translated verbatim from the French by Colosi. Rostand, the herpetological Fabre, made detailed studies of the following aspects of toad life: diet, special senses and capacities, poison, enemies, and parasites, pairing, oviposition, clasping reflex, rivalry of males, eggs and larvae, hermaphroditism in male toads, toadlets, etc. An English edition of Rostand's classic work, translated by Joan Fletcher, was published in 1934 by Methuen and Co., Ltd.

In this Italian edition Rostand's original photographs have not been used, but excellent photographs and drawings have been supplied by Colosi.

Colosi has also translated Rostand's studies of the biology of dragonflies devoted to morphology, physiology, flight, habits, reproduction, oviposition, habits of the nymph, although Colosi chooses to translate the latter as "larve." The book is attractively jacketed with a color plate of a toad and dragonfly.—ROMEO MANSUETI, *Maryland Department of Research and Education, Solomons, Maryland.*

DIE LURCHE UND KRIECHTIERE DES RHEIN—MAIN—GEBIETES. By Robert Mertens. Verlag Dr. Waldemar Kramer, Frankfurt, A. M., Germany, 1947: 1-144, figs. 1-20, plates 1-32.—In his customary thorough style, Dr. Mertens, of the Senckenbergischen Naturforschenden Gesellschaft zu Frankfurt am Main, has published a valuable handbook of the amphibians and reptiles of the Rhein and Main River drainage systems in the vicinity of Frankfurt. Mertens states, "From a geographical as well as biological standpoint, there are two different sections of the Rhein flowing through the Rhein-Main area." He describes the rather complex drainage area involving various tributaries of the Rhein and of the Weser. He divides the region into four major forests on the basis of their isolation by stream systems. Addi-

tional information on the ecological aspects of the region is provided in an essay of a general survey of herpetofauna of the Frankfurt region.

Mertens presents a rather detailed discussion of the distribution of species in the Rhein-Main region by analyzing his data from the drainages of the various tributaries. He also summarizes previous investigations, of which there are many since a number of zoologists have worked in the region of Frankfurt, Heidelberg, Mannheim, Marburg, Worms, etc.

A dichotomous key to the 30 kinds of amphibians and reptiles precedes the actual discussion of each species, to which almost the entire book is devoted. Mertens records six kinds of salamanders, twelve species of toads and frogs, one turtle, five kinds of lizards, and six kinds of snakes of which only the adder, *Vipera b. berus* is poisonous. In the discussion of each species the following is covered: common and scientific name, short description, habitat, habits, behavior, and reproduction, general distribution, distribution in the Rhein-Main area, and detailed locality records. Throughout the text outline maps of the region show the locality records of each species. A detailed bibliography is given, and each form is indexed by scientific name. One colored plate and an excellent series of photographic reproduction of each species are included. The illustration of the "Balzkampfen" or combat dance of male *Vipera b. berus* is of particular interest.—ROMEO MANSUETI, *Maryland Department of Research and Education, Solomons, Maryland.*

SOME ASPECTS OF THE PHYSIOLOGY OF FISH. By W. S. Hoar, V. S. Black, and E. C. Black. Publ. Ontario Fish. Res. Lab., No. 71, Univ. Toronto Press, 1951: 1-111.—By staff members of the University of British Columbia; in three parts: I. Hormones in Fish; II. Osmotic Regulation in Teleost Fishes; and III. Respiration in Fishes. Each section has its own summary and a list of references, in all 469 titles.

THE DILEMMA OF THE PALEONTOLOGIST. By E. C. Case. Contr. Mus. Paleo. Univ. Mich., 9 (5): 173-215. 1951. $.75.—A thought-provoking, critical review of evolutionary theories worthy of careful reading by all biologists.

THE OCEAN SUNFISHES (FAMILY MOLIDAE). By A. Fraser-Brunner. Bull. British Mus. (Nat. Hist.), Zool., 1 (6); 1951: 87-121, 18 figs. 7/6d.—Three genera in two subfamilies are recognized, with keys for identification and full synonymies. Atrophy of the posterior end of the vertebral column is the main peculiarity of the group. *Masturus* only appears to have caudal rays; its two species may prove to be different sexes of the same species.

FRESHWATER FISH AND FISHING IN NATIVE NORTH AMERICA. By Erhard Rostlund. Univ. Calif. Publ. Geogr., 9, 1952: 1-314, 1 fig., 47 maps. $3.50.—An investigation to distinguish and explain regional and seasonal differences in the fish fauna, to quantitatively evaluate the fishing opportunity of the Indians, and to express the results cartographically; also, to evaluate and map the relative economic significance of the Indian fishery. The distribution maps and, particularly, the map of North American fish provvinces, should awaken ichthyographers from their long lethargy in the field of zoogeography.

FRESH WATER FISHES OF THE PACIFIC COAST. IDENTIFICATION. By Charles Everett. Binfords and Mort, Publishers, Portland, Oregon, 1949: 45 pp., 46 line drawings. 50¢.—A handy tacklebox guide to the basic fish types of interest to the fisherman and layman. Scientific and common names, size, color, range, and brief general notes are included.

JORDAN, DAVID STARR: A BIBLIOGRAPHY OF HIS WRITINGS, 1871–1931. Compiled by Alice N. Hays. Stanford Univ. Publ., Univ. Ser., Library Stud., 1, 1952: xv + 195 pp. $4.00.—Because of Jordan's varied interests, his bibliography is arranged in two parts: Part I includes Generalia, Education, International Relations, and Science, and Part II is devoted to Ichthyology. Each part is separately indexed, that to ichthyology by titles and authors as well as by scientific names. It is not claimed that the bibliography is complete, but certainly less than 5 percent of his fish papers are missing. Jordan published at least 645 scientific contributions in ichthyology, but he also wrote some 1,372 books and papers in other fields. This bibliography is therefore not only of great interest and value to ichthyologists and fishery biologists but to scholars in several fields.

GENETICS IN THE 20TH CENTURY. ESSAYS ON THE PROCESS OF GENETICS DURING ITS FIRST 50 YEARS. Edited by L. C. Dunn. The Macmillan Co., New York, 1951: xi + 634 pp., illus. $5.00.—A compilation of 26 papers by distinguished geneticists that constitutes a valuable review of the science since its inception. Each paper evaluates a different phase of genetics and each is written in a language and style readily comprehensible to the general biologist. Chapters on biometrical genetics (Mather), cytogenetic mechanisms in animals (White), Mendelian populations and their evolution (Dobzhansky), and Genetics, evolution, and human destiny (Huxley) will be of particular interest to students of evolution.

UNDER THE SEA-WIND. A NATURALIST'S PICTURE OF OCEAN LIFE. By Rachel L. Carson. Oxford University Press, New York, 1952: 314 pp., illus. $3.50.—This charming book was reviewed in COPEIA, 1942 (2): 130. The 1941 edition is out of print and has been reissued "with corrections."

ESTUDIOS SOBRE BATRACIOS ANDINOS. I. EL GRUPO *TELMATOBIUS* Y FORMAS AFINES. By J. Vellard, Memorias del Museo de Historia Natural "Javier Prado," No. 1, Universidad Nacional Mayor de San Marcos, Argentina, 1951: 1-89, 8 pls.—The pleasing format of the printed pages of this first issue of the new publication is followed by rather mediocre halftone reproductions of what were obviously good photographs.

ZOOLOGICAL RECORD: AMPHIBIA AND REPTILIA. Compiled by J. C. Battersby and W. E. Swinton. Vol. 86, Sect. 16, 1949. Published in October, 1951. 7s 6d. 1001 titles.

NOTES AND NEWS

Constitution and By-laws of the American Society of Ichthyologists and Herpetologists

Adopted June 29, 1951

(With amendments of April 13, 1952)

CONSTITUTION

ARTICLE I: NAME

The name of this Society shall be "The American Society of Ichthyologists and Herpetologists." The Society is incorporated in the District of Columbia (November 22, 1949).

ARTICLE II: OBJECT

The object of this Society shall be to advance the science of the study of fishes, amphibians and reptiles.

ARTICLE III: MEMBERSHIP

Section 1. Members shall be chosen from among persons interested in the object of the Society.

Section 2. The membership of the Society shall consist of two classes.

a. Active Members shall consist of those who pay the annual dues or who are Life Members.

b. Honorary Foreign Members shall be chosen from among the ichthyologists and herpetologists, located outside of the United States, who have attained distinction as investigators. The Honorary Foreign Members shall be equally divided between ichthyologists and herpetologists.

Section 3. Nomination to membership shall be upon the recommendation of one member.

ARTICLE IV: OFFICERS

Section 1. The officers of the Society shall be: Honorary Presidents John Treadwell Nichols (ichthyology) and Helen T. Gaige (herpetology) for life. A President, elected for a two-year term, eligible for a second term only after a lapse of two or more years, office to alternate between an ichthyologist and a herpetologist; three Vice-Presidents elected for a one-year term but eligible for immediate re-election; a Treasurer, a Secretary, a Publications Secretary, and a Historian, all of whom must be re-elected annually but who may serve unlimited consecutive terms; an Editor-in-Chief, an Ichthyological Editor, a Herpetological Editor and an Editorial Board of five members, each of whom shall be elected annually but who may serve unlimited consecutive terms.

Section 1 amended April 13, 1952. The office of Historian was abolished.

Section 2. The officers shall be elected from among active members in good standing by ballot sent to the membership by the Secretary at least one month before the annual meeting. The slate of nominees shall be furnished the Secretary by a nominating committee of five members to be appointed by the President at the time of the annual meeting. The term of office shall commence with the close of the annual meeting except for the

Treasurer who shall take office on January 1 following his election.

Section 2 amended April 13, 1952, with respect to the election of officers. The officers shall be elected at the annual business meeting from among active members in good standing. The slate of nominees shall be furnished by a nominating committee of five members to be appointed by the President at or shortly after the time of the previous annual meeting.

Section 3. The officers named in Section 1 shall discharge the duties usually assigned to their respective offices (see by-laws).

Section 4. The business of the Society shall be conducted by a Board of Governors. The Board shall consist of not more than 50 elective members, each elected for a term of 5 years. Elective members of the Board whose terms have expired at the time of the annual meeting shall not be eligible for re-election to the Board until the time of the next annual meeting. The incumbent officers of the Society including those of the Western Division, shall be ex-officio members of the Board. Former Presidents of the Society shall be members of the Board for life.

Section 5. Vacancies in the membership of the Board of Governors shall be filled by the Board of Governors at the time of the annual meeting.

Section 6. A vacancy in either the Secretaryship or Treasurership occurring in the interval of the meetings of the Society may be filled, until the next annual meeting, by appointment by the President.

Section 7. The Executive Committee required for purposes of incorporation shall consist of the officers of the Society.

Article V: Meeting of the Society

Section 1. This Society shall hold an annual meeting.

Section 2. The place of the annual meeting of the Society shall be determined by the Board of Governors. Notice of the meeting shall be mailed to all members of the Society at least three weeks before the date set for the meeting.

Article VI: Western Division

Section 1. The Western Division of the Society shall consist of those members from Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, Hawaii, Alaska, Alberta and British Columbia.

Section 2. The Western Division shall elect its own Officers, President, Vice-President, and Secretary-Treasurer, and hold annual meetings.

Article VII: Quorum

Twenty-five members shall constitute a quorum of the Society and ten a quorum of the Board of Governors.

Article VIII: Changes in the Constitution

Section 1. Amendments to this constitution may be adopted at any meeting of the Society if approved by two-thirds of the members of the Board of Governors voting and two-thirds of the members voting at the annual business meeting.

BY-LAWS

Article I: Dues

Section 1. Dues for active members shall be $5.00 a year. Copeia shall not be sent to those in arrears for dues. Upon payment of arrearage, the former member shall be reinstated.

Section 2. Annual dues for active foreign members shall be $4.50.

Section 3. Annual dues shall be payable January 1, in advance.

Section 4. The annual subscription rate for Copeia shall be $6.00.

Section 5. Upon payment of $100.00 any active member may become a Life Member. The amount may be paid in one sum or four annual payments of $25.00 each. All sums paid by Life Members shall be kept in a separate account, the Endowment Fund, during the lifetime of the Member.

Article II: President and Vice-Presidents

Section 1. The President shall preside at sessions of the Board of Governors and at the business meeting.

Section 2. The President shall also appoint the committees prescribed by the constitution and by-laws.

Section 3. The Vice-Presidents shall preside at sessions designated by the President and, in order, shall assume the duties of the President in the latter's absence.

Section 4. The Vice-Presidents shall have added responsibilities as follows: a. The First Vice-President shall have charge of all conservation matters and shall serve as Chairman of the Conservation Committee. b. The Second Vice-President is designated as Finance Vice-President and shall act as Chairman of a finance committee of five members including the Secretary and Treasurer. This committee will have the duty of advising and directing the treasurer and other officers in the management and investment of all funds and monies of the Society. c. The Third Vice-President shall be expected to devote his attention to the obtaining

of new members, in all classifications, and shall be Chairman of the Membership Committee.

ARTICLE III. SECRETARY

Section 1. The Secretary shall keep the records of the Society and report at the annual meeting.

Section 2. He shall be responsible for sending out notices announcing the annual meeting and for arranging the agenda for the Board of Governors and business meeting at the annual meeting.

Section 3. He shall be reimbursed out of the monies of the Society for expenses incurred in attending meetings of the Society.

Section 4. He shall make such purchases and employ such assistance as is necessary to conduct the business of the Society within limits to be set annually by the Board of Governors.

Section 5. Unless other arrangements are made at the annual meeting he shall act as delegate or representative of this Society at meetings of related societies covering matters of mutual interest.

ARTICLE IV: TREASURER

Section 1. The Treasurer shall be in charge of the funds and securities of the Society.

Section 2. At the annual business meeting of the Society he shall present a statement of the funds and monies of the Society, the statement to cover the calendar year.

Section 3. The President shall annually appoint an auditing committee of two, who shall audit and report upon the financial record and statement of the Treasurer at the annual business meeting.

ARTICLE V: PUBLICATIONS SECRETARY

Section 1. The Publications Secretary shall be charged with the responsibility for the safe storage and sale of back numbers of Copeia.

Section 2. He may employ such assistance as is necessary upon approval of the Secretary and Treasurer.

Section 3. He shall prepare a report covering the back number business for presentation to the Society at its annual meeting.

ARTICLE VI: HISTORIAN

Section 1. He shall be responsible for the Permanent Archives of the Society and shall prepare a report to be given at the annual meeting of the Society.

By amendment of April 13, 1952, Article VI was deleted.

ARTICLE VII: PUBLICATIONS COMMITTEE

Section 1. The Editors, Editorial Board, President, Secretary, Publications Secretary and Treasurer shall constitute the Publications Committee of the Society.

Section 2. Matters pertaining to publication costs and similar matters shall be the responsibility of this committee.

ARTICLE VIII: MEETINGS

Section 1. The chairman of the local committee shall be appointed by the President, if possible at least 6 months before the time of the meeting.

Section 2. The chairman of the local committee shall be responsible for all local arrangements including the arrangements for printing the program.

ARTICLE IX: FUNDS

Section 1. The Frederick H. Stoye Fund shall remain invested (in bonds) until maturity and then be reinvested with the principal left intact. The income is to be used to offer awards for meritorious papers presented by student members at the annual (National) meeting. After the demise of Mr. Stoye the principal of the fund is to remain invested as now and the income used to provide student awards at *all* the meetings or to be used in any manner that the officers of the society may decide. The prizes awarded at the meetings are to be known as the Frederick H. Stoye Awards.

Section 2. The Revolving Research Fund is available for small grants to younger members for assistance in research. There is no obligation to repay these grants although it is expected that recipients will contribute a like or greater sum to the fund when professionally established and able to do so.

Section 3. The Endowment Fund shall consist of donations and payments received from Life Members. Only the income from the Life Membership payments may be used by the Society during the lifetime of the member. Upon death of a life member the principal may be transferred to the current account of the Society.

ARTICLE X: GIFTS AND BEQUESTS

Section 1. Gifts, donations, and bequests may be given directly to the Society.

Section 2. Unless some special purpose accompanies such gift, donation, or bequest, the Board of Governors of the Society may disburse the principal or income for the object of the Society as specified in the Constitution under Article II.

ARTICLE XI: ANNIVERSARY AND MEMORIAL NUMBERS OF COPEIA

Nominations pertaining to Anniversary and Memorial numbers shall be submitted in writing to the President at least three months in advance of the annual meeting. Such nominations shall be

studied by a committee consisting of the officers of the Society, and if approved by this committee, the nominations shall be submitted to the Board of Governors at the annual meeting for its action. If the committee is not in favor of the nomination, the secretary shall so inform the person making the original proposal.

ARTICLE XII: HONORARY FOREIGN MEMBERS

The number of Honorary Foreign Members shall not exceed 20.

ARTICLE XIII: SOCIETY SET OF COPEIA

An official bound set of Copeia shall be maintained in the office of the Editor-in-Chief.

Article XIII amended April 13, 1952. A second official bound set of Copeia shall be maintained in the office of the Secretary.

ARTICLE XIV:

Procedures and other items, not specified in the Constitution or By-Laws of this Society or by action at the annual meeting, shall be in accordance with Roberts Rules of Order.

The editors of COPEIA have decided to print, occasionally, brief signed editorials or expressions of opinion on topics which will be of general interest to readers or which express a general viewpoint on questions of a controversial nature. Usually such editorials or opinions will be solicited by the editors, but readers who believe they have something of a general nature to say are invited to submit copy. Personalities or immoderate wording should be avoided, and the contributions should not in general be over one printed page in length. The first such communication, "Tower of Babel," by GEORGE S. MYERS, is printed in this issue.

Tower of Babel

Last year the writer made a list of the languages he would have to be able to read with some fluency if he were to keep reasonably well informed of the more important developments in his own special fields of scientific interest—ichthyology, herpetology, and zoogeography, plus a little evolution and ecology. Before he quit in disgust, the list had risen to 20, including Russian, Polish, Dutch, Afrikaans, and Japanese! Such conditions are preposterous in a world in which science is presumed to be international and few scientists can claim to read more than two or three languages outside their mother tongue.

A few of the writer's colleagues, whose scientific interests and work are confined to some particular problem in fishery biology or to the fauna of one country or continent, refuse to be alarmed, and point out that you can get almost anything translated. Unfortunately, the translation needs of persons with this attitude usually turn out to be not over three or four papers per year, but those of the systematist or zoogeographer, if he has any but local interests, demand annual knowledge of hundreds of papers in many languages. Some problem worked out recently in the Adriatic or Bolivia or Japan may vitally affect the interpretation of research progressing in Texas or Chesapeake Bay or the Transvaal, which is one reason why systematic work done from a purely local viewpoint must often be redone or reinterpreted by someone with a broader view and wider knowledge of the literature. If the worker cannot read the literature himself, he simply has to ignore it, for in this type of work abstracts or summaries are seldom of much practical value and getting a hundred or more papers translated every year is simply out of the question.

The result is that most of the papers printed in languages other than the three principal scientific ones (English, German, and French) are unavailable to the majority of workers, and, so far as the latter are concerned, might just as well never have been published. Truly, science is ceasing to be international.

Time was when scientific men had to know but a single international language (Latin) besides their own, but with the rise of the tide against medieval scholasticism, scientific papers and books began to appear in the vernacular. By 1820, Latin had almost disappeared from zoology, but for almost exactly the next hundred years little zoology of any importance was published in any language but German, English or French. Manuals for identification of the local fauna are the principal exception, and there can be no great criticism of this. Since 1920, however, rising nationalisms, combined with the expanding geographical distribution of scientific research and the contracting radius-of-interest of the average individual scientist, has produced a general and increasing linguistic and scientific myopia, especially on the part of those zoologists whose mother tongue does not happen to be one of the three languages in which the most important part of the scientific literature has been written. Indeed, things have gone so far that we see such an incomprehensible spectacle as the publication of an important paper on the morphology of a South American frog written in Afrikaans, a language which no interested South American zoologist can read or can reasonably be expected ever to read.

In ichthyology, the writer is especially concerned about the increasing number of systematic and fishery papers being published in Japanese, with (or without) a perfectly useless short summary in English or German. Students of Japanese say

that the language is a peculiarly inexact one, poorly fitted for precise scientific expression. Besides, it is exceptionally hard to learn, and, with other and more useful scientific languages to deal with, almost no non-Japanese zoologist has time to learn it. Under these conditions, ichthyologists who publish in Japanese (like South Africans who publish in Afrikaans) should realize that practically no one outside their own country is going to read their papers or pay much attention to their results.

Dutch-, Flemish-, and Scandinavian-speaking zoologists have, on the whole, taken the reasonable attitude that others cannot be expected to learn their languages, and have published largely in French, German or English. Much the same was true of Russian zoologists until relatively recently. Can any zoologist be so blind as not to see that his own recognition among the scientists of the world, to say nothing of the extent to which his results will be used or ignored, demands that his papers be written in a language understood by all the workers in his field?

The writer feels that something should be done about this scientific Tower of Babel. So far as systematic zoology is concerned, a large part of the problem could be neatly solved by the International Congress of Zoology, simply by adding to the International Rules of Zoological Nomenclature a non-retroactive provision that papers, the complete texts of which are not printed in any one of a selected group of languages, be considered unpublished for nomenclatural purposes. Restricting the rule to description of new taxonomic units would be quite useless. Witness the current general prostitution of the international botanical rule that Latin descriptions must be given of new plant species. The present writer's language selections would be: Latin, English, German, French, and those three internationally understood Romanic languages that are read with some facility by persons familiar with Latin or French—Spanish, Portugese[1], and Italian. None of the several manufactured "international" languages, such as Esperanto, have ever had enough currency in zoological circles to merit consideration.—GEORGE S. MYERS.

News Notes

PERCY S. BARNHART died on December 23, 1951, at the age of 70. For 32 years he was Curator of the Museum and Aquarium at Scripps Institution of Oceanography, retiring in 1946. Mr. Barnhart was best known for his "Marine Fishes of Southern California," and published other articles on the fishes of southern California and their life history.

[1] Those who may object to Spanish or Portugese on the basis of their small scientific currency in Europe should realize that Spanish is the native tongue of over a third of all the Americas, and Portugese of half of South America.

J. LOUIS TROEMNER, one of the leading American aquarists, died on November 27, 1951, at Philadelphia, at the age of 67. For 28 years he was editor of "The Fish Culturist."

Facilities for studies in marine biology are now available at the Institute of Marine Science of The University of Texas. Course work and problems for qualified graduates are offered in ecology and fisheries biology under M. D. BURKENROAD and G. GUNTER. Living quarters and a research vessel are available. The dock-laboratory on Aransas Pass provides unique opportunities for a variety of investigations. Enquiries should be addressed to the Acting Director, Port Aransas, Texas.

DR. NELSON MARSHALL has joined the staff of the Oceanographic Institute, Florida State University, Tallahassee, Florida, effective January 1, 1952.

DR. FRANK F. HOOPER recently resigned from a position of Instructor in Zoology in the University Michigan to become a Biologist in the Institute for Fisheries Research of the Michigan Department of Conservation and the University of Michigan. His principal research activities will be in limnology and basic problems of fish production in lakes in the southern part of the state.

DR. ARTHUR W. HENN, Treasurer of this Society until 1950, has retired from the Carnegie Museum after an association of nearly forty years. He now resides in Winter Park, Florida.

DR. JOSÉ ALVAREZ is now head of the Laboratorio de Hidrobiología, Sociedad Mexicana de Hidrobiología, Apartado Postal 30491, México, D. F.

DR. W. M. CHAPMAN has resigned from his position as Special Assistant to the Under Secretary of State, where he was on leave from the directorship of the School of Fisheries of the University of Washington, to accept a position as Director of Research for the American Tunaboat Association in San Diego, California. This organization consists of the owners of about three-fourths of the tuna clippers which fish in the high seas areas of the Eastern Tropical Pacific Ocean, from San Diego to off the coast of northern Perú, and all intervening seas. The purpose of this newly created position is primarily to act as a liaison between the operators of these tuna vessels and the numerous scientists who are investigating the ocean and its resources in this area, such as those employed by the Scripps Institution of Oceanography, the California Bureau of Marine Fisheries, the Southern Pacific investi-

gations and the Pacific Ocean fisheries investigation of the U. S. Fish and Wildlife Service, the Inter-American Tropical Tuna Commission, etc., with a view to applying the information gained by this scientific work to the practical problems of the tuna fishery.

We are shocked to learn of the tragic death of GUS A. ENGELING, a member of our Society from Rockport, Texas. In charge of the state game refuge at Bethel, he was shot by a local man while the latter was attempting to escape apprehension for illegally shooting two ducks on the refuge. A big price exacted by two ducks!

The GEORGE VANDERBILT Pacific Equatorial Expedition of 1951 returned in September after a 3½ months cruise through the Hawaiian, Leeward and Line Islands. Under the joint sponsorship of the Academy of Natural Sciences of Philadelphia and the California Academy of Sciences, the Expedition obtained the largest fish collections as yet taken from the Leeward and Line Islands. Preliminary indications are that there will be many new records as well as species. The Expedition was under the personal direction of GEORGE VANDERBILT. EARL S. HERALD, Curator of Aquatic Biology of Steinhart Aquarium, California Academy of Sciences, aided in the organization of the biological work and made the cruise through the Line Islands. VERNON E. BROCK, Director of the Hawaiian Division of Fish and Game, made the Leeward Island cruise as the official observer of the territorial government. ROBERT R. HARRY, graduate student in ichthyology at Stanford University, made both cruises. The fish collections are now being sorted at the California Academy of Sciences with reports on the collections being made by ROBERT HARRY and some groups being reported by EARL HERALD.

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